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Functional Safety Assessment of a Generic, Conventional, Hydraulic Braking System with Antilock Brakes, Traction Control, and Electronic Stability Control

Appendices

APPENDIX A: CURRENT SAFETY ISSUES FOR THE CHB SYSTEM

This appendix summarizes the findings from this study's review of current safety issues related to the CHB system. This study examined crash databases, and NHTSA's vehicle recall and VOQ databases to identify potential safety concerns related to the CHB system.

General Estimates System and Fatality Analysis Reporting System

In 2012, there were an estimated 5.6 million police-reported crashes involving vehicles of all types in the General Estimates System database[1] and 30,800 fatal crashes in the Fatality Analysis Reporting System database[2]. Although they represent two distinct databases, as a result of an effort to standardize the FARS and GES databases in 2010, these two databases now include similar data. The data contained in FARS are actual counts and the data in GES represent a nationally weighted sample of crashes.

Volpe analyzed the 2012 GES and FARS crash databases to identify crashes at least partially attributable to brake system issues. The GES and FARS crash databases, however, do not differentiate between different types of brake systems (e.g., CHB versus regenerative braking) and do not identify specific failure modes that may have contributed to the crash. The brake system entry in these databases also includes the parking brake system.

The data element "ACC_TYPE" was used to determine the crash category that best describes the type of crash that the vehicle was involved in based on the pre-crash circumstances. To determine if the vehicle had a pre-existing brake system issue that may have contributed to the crash, the data element "MFACTOR" was used. More information on the coding can be found in the user's manuals of these databases.

Review of the GES database identified 32,477 crashes (0.58%) at least partially attributable to braking issues. The FARS database identified 95 crashes (0.31%) at least partially attributable to braking issues. The most common braking-related crash type identified in the GES database is a rear-end collision. In the FARS database, right roadside departures are the most common braking-related crash type.

[1] The GES database contains crash statistics on police-reported crashes across the United States involving all types of vehicles. The information comes from samples of police reports for over five million crashes that occur annually. The database is weighted to characterize a nationally representative sample. Each crash must involve at least one motor vehicle travelling on a roadway that results in property damage, injury, or death, and it must be obtained from a police report. [3]

[2] The FARS database contains information on all crashes in the United States involving at least one fatality resulting from the crash. The fatality can be either an occupant of the vehicle or a non-motorist, such as a pedestrian, and it must have occurred within 30 days of the crash. The crash must have occurred on a public roadway. [4]

NHTSA Motor Vehicle Recall Campaigns

This study reviewed 104 motor vehicle recall campaigns[3] for model year 2002 to 2015 light vehicles related to brake systems. The review covered recalls through October 8, 2014. Each recall campaign was assessed based on publically available information to determine how the brake system may have become unsafe, contributing to a vehicle-level hazard.

The results are categorized based on the STPA UCA guide phrases described in Section 2.2.3 of this report. Figure A-1 shows the results of this analysis.

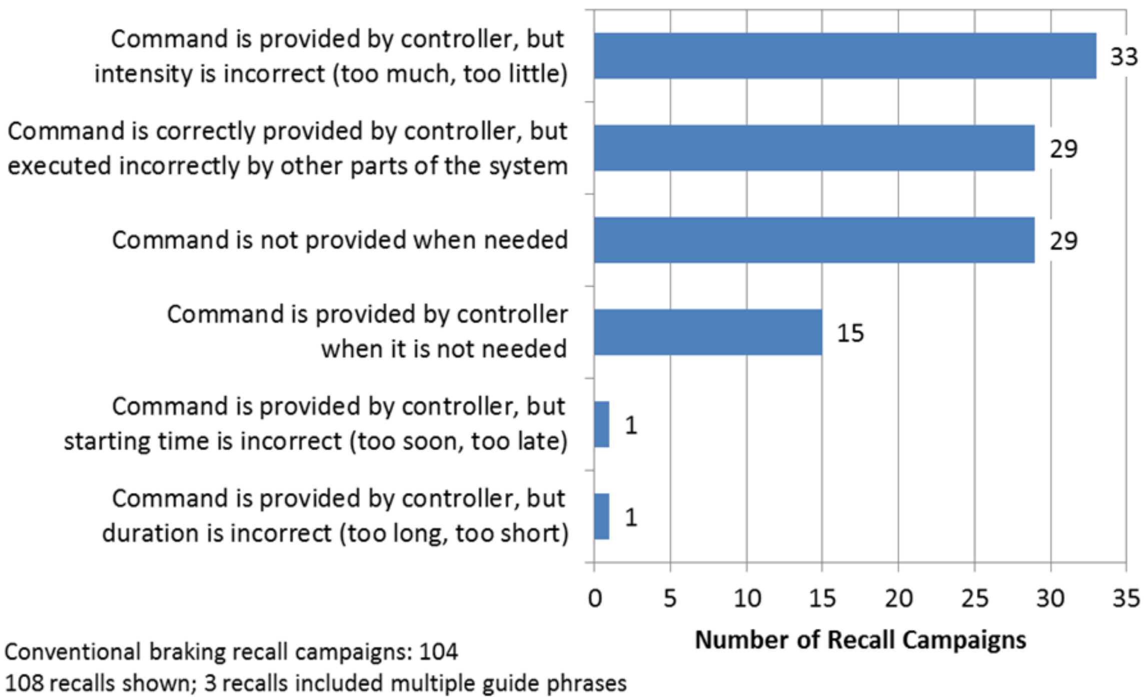


Figure A-1: Unsafe Control Action Breakdown of Brake System Recalls

The largest category of braking-related recalls describe situations where braking was delivered with the wrong intensity (i.e., too much or too little braking). The second largest category of braking recalls describe failures the mechanical braking pathway (e.g., brake modulator, hoses, etc.) that affect implementation of a braking command.

[3] Either NHTSA or the manufacturers may issue recalls due to vehicle or equipment defects once it is determined that a safety defect exists in a motor vehicle or items of motor vehicle equipment that poses a risk to safety [5]. CFR 49 Volume 7 Part 573.6 [6] requires the manufacturer to furnish a report to NHTSA for each defect once a recall is warranted.

Each recall was further categorized based on the potential CFs contributing to the recall. The CF categories used for the analysis are presented in Appendix B. Figure A-2 provides a breakdown of the braking-related CFs.

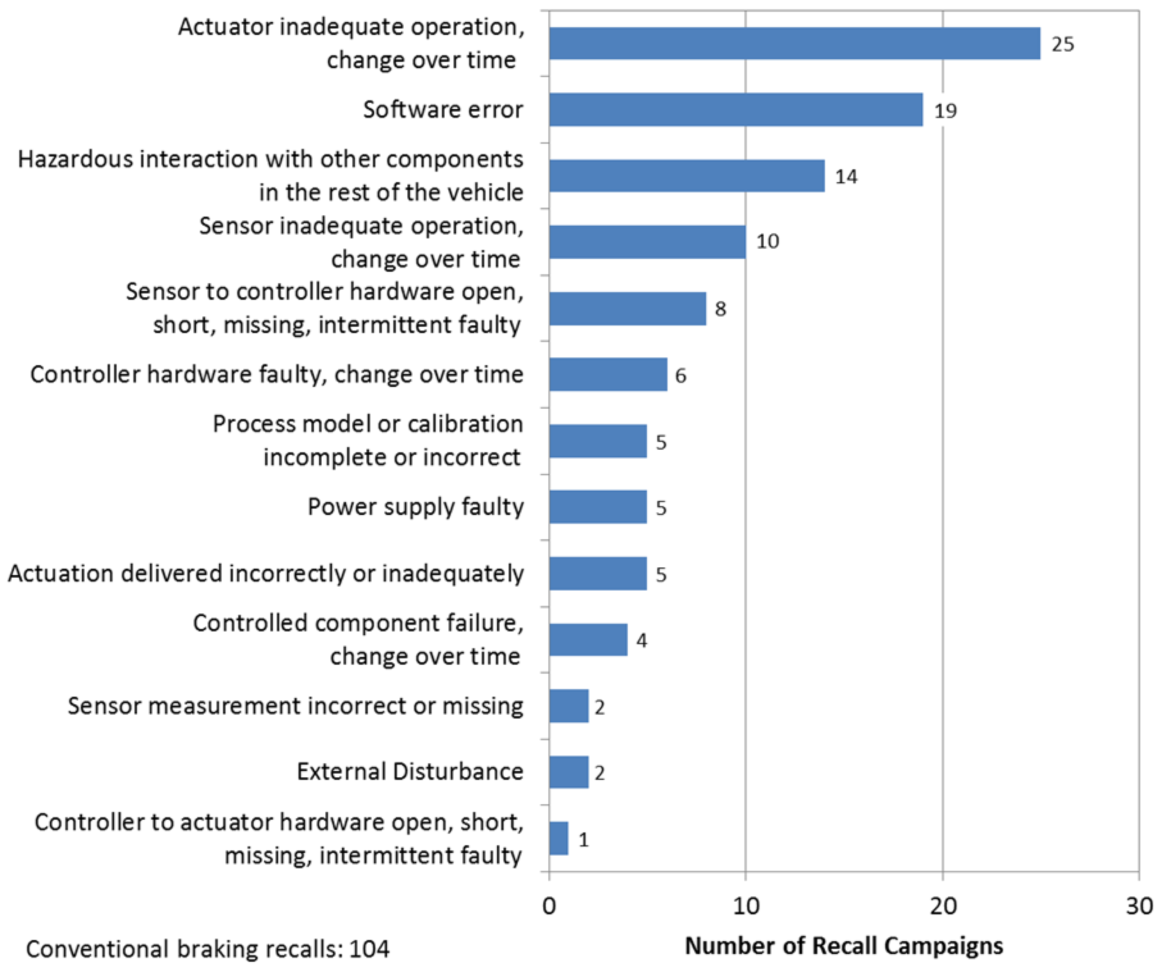


Figure A-2: Causal Factor Breakdown of Brake System Recalls

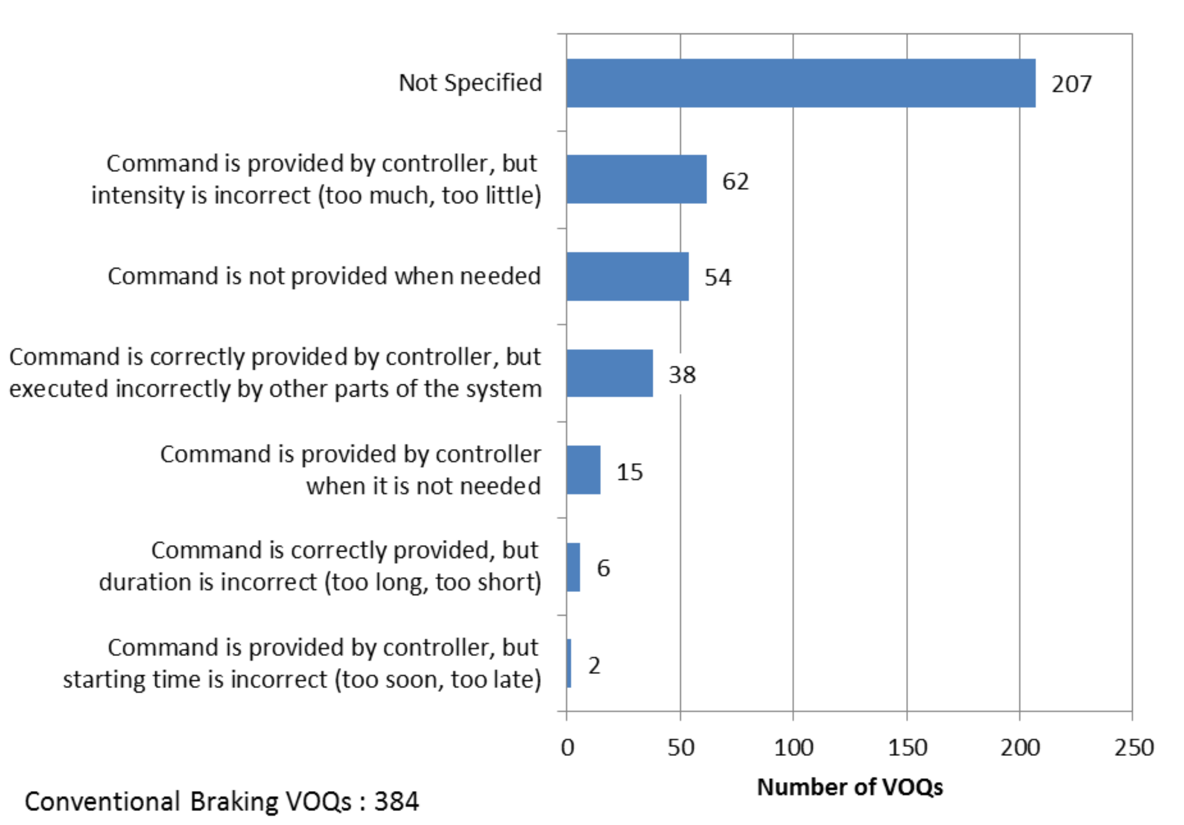
The largest percentage of recall campaigns related to the brake system cited failure of the actuating components, such as the brake modulator, brake pads/drums, and other mechanical parts associated with delivering braking force to the wheels. The second highest percentage of recall campaigns cited software failures, such as faults in the ESC or ABS algorithms.

NHTSA Vehicle Owner Questionnaires

Vehicle owners can express their safety concerns to NHTSA via the vehicle owner questionnaire mechanism. NHTSA's Defects Assessment Division screens more than 30,000 VOQs annually to inform their decisions on issues requiring further investigation [5].

Volpe reviewed 384 VOQs related to the brake system. These are only a subset of the available braking-related VOQs and were identified by searching the VOQ database for the terms "ABS" and "ESC." The VOQ search was also limited to manufacturers with greater than one percent market share for light vehicles. [6] [7]

The data obtained from the VOQs were categorized in a similar manner as the recalls. Figure A-3 shows the breakdown of the VOQs by UCA category. Figure A-4 shows the breakdown of VOQs by CF category.



A-3: Unsafe Control Action Breakdown of Brake System VOQs

The majority of the braking-related VOQs did not specify the unsafe behavior. Of the VOQs that could be categorized by an unsafe control action, the most prevalent cause was braking with the wrong intensity.

As shown in Figure A-4, most of the brake-related VOQs did not have a specified or even speculative cause of the failure. Of the VOQs that provided a cause, hardware failures in both the controller and actuators for the system (e.g., brake modulator) were the most frequently reported cause of malfunctions. Note that VOQs are often submitted by vehicle owners based on perceived vehicle behavior and the vehicle owners submitting VOQs may not have technical expertise on how the system operates.

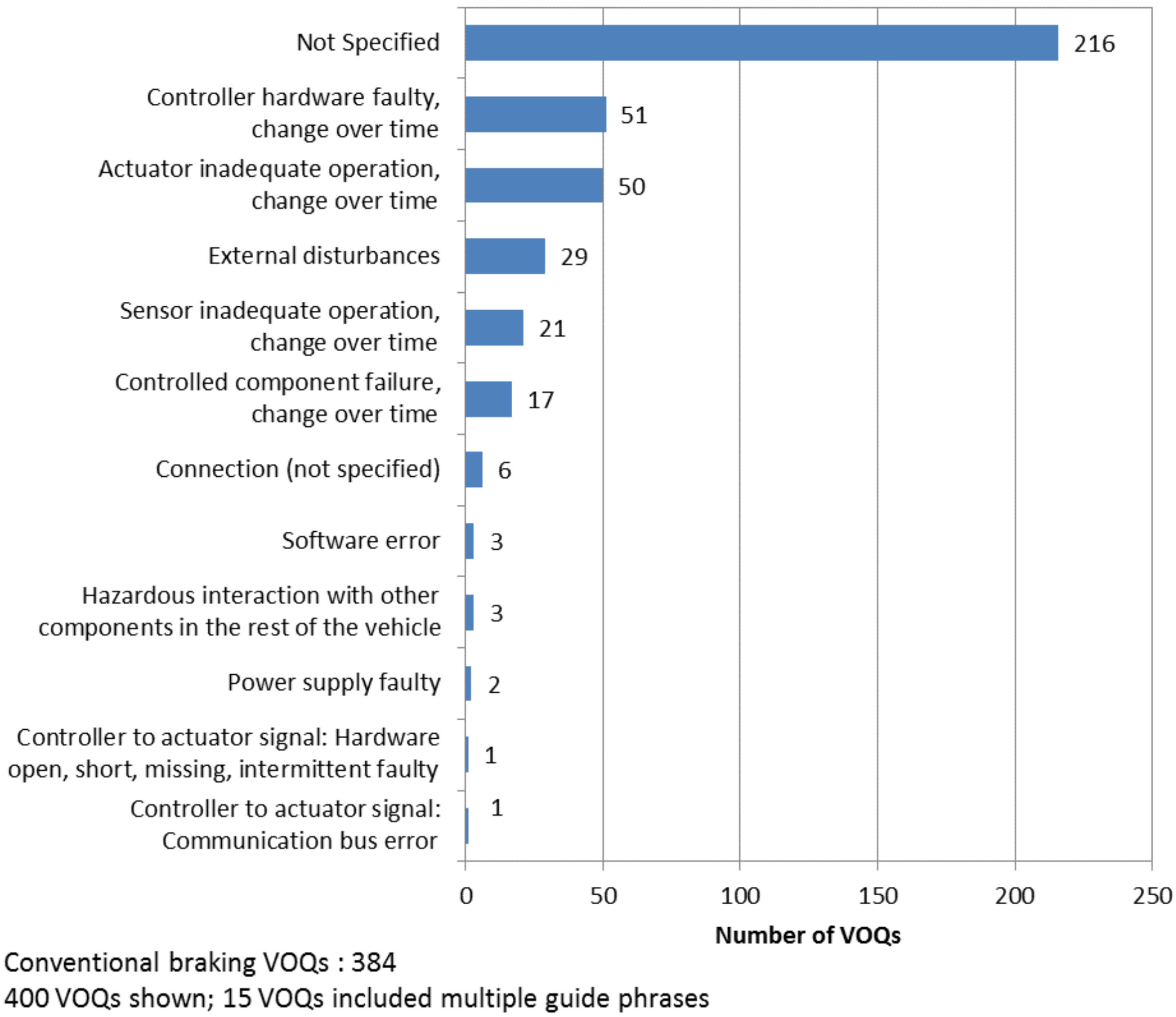


Figure A-4: Causal Factor Breakdown of Brake System VOQs

APPENDIX B: STPA CAUSAL FACTOR GUIDEWORDS AND GUIDEWORDS SUBCATEGORIES

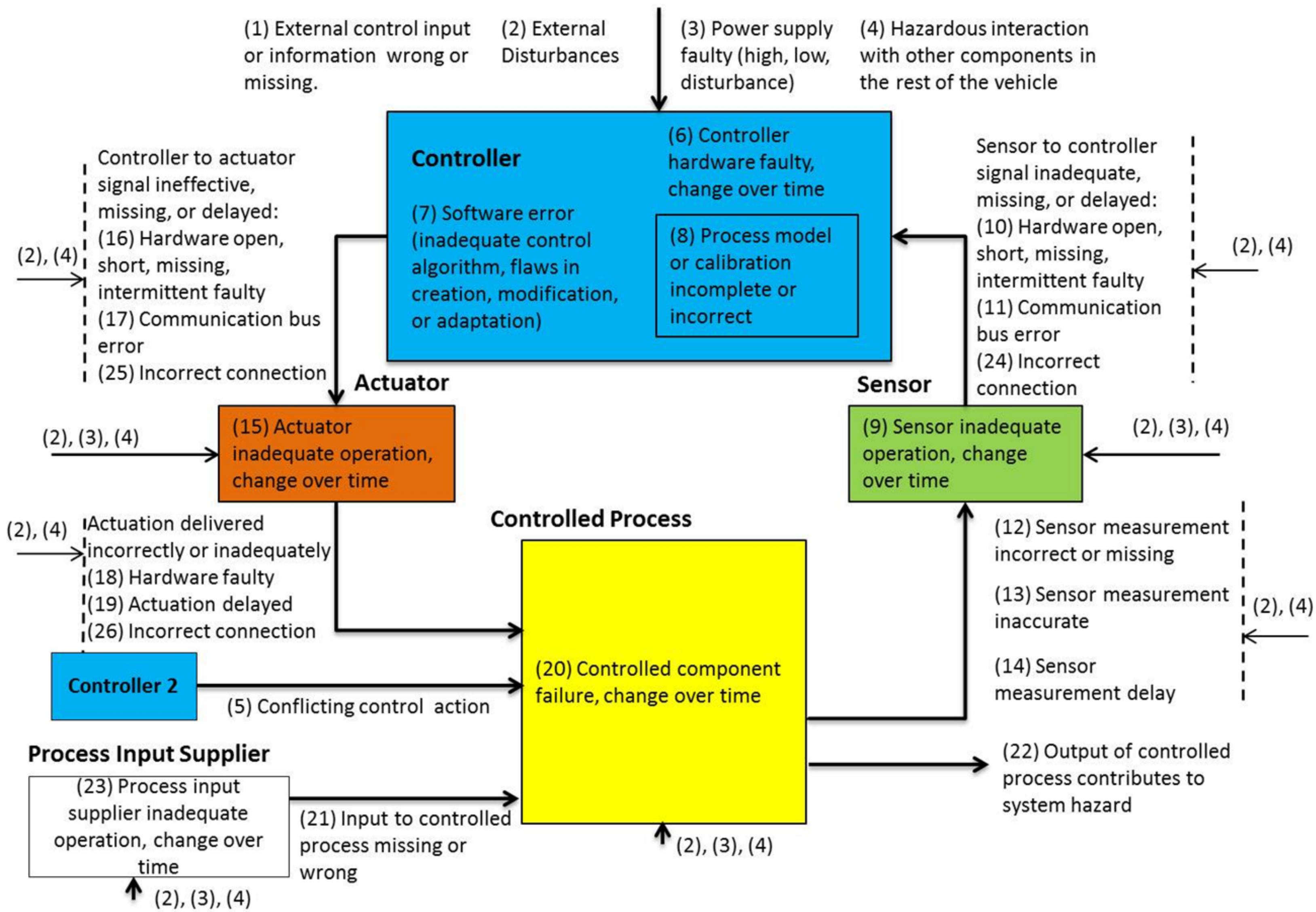


Figure B-1. Causal Factor Categories for Automotive Electronic Control Systems

Table B-1. Causal Factor Sub-categories for Automotive Electronic Control Systems

The numbering in the table below corresponds to those in Figure B-1.

Components	
Controller	**(6) Controller hardware faulty, change over time** • Internal hardware failure • Overheating due to increased resistance in a subcomponent or internal shorting • Over temperature due to faulty cooling system • Degradation over time • Faulty memory storage or retrieval • Faulty internal timing clock • Faulty signal conditioning or converting (e.g., analog-to-digital converter, signal filters) • Unused circuits in the controller
	(7) Software error (inadequate control algorithm, flaws in creation, modification, or adaptation) • Inadequate control algorithm • Flaws in software code creation
	(8) Process model or calibration incomplete or incorrect • Sensor or actuator calibration, including degradation characteristics • Model of the controlled process, including its degradation characteristics
	(2) External control input or information wrong or missing • Timing-related input is incorrect or missing • Spurious input due to shorting or other electrical fault • Corrupted signal • Malicious Intruder
	(3) Power supply faulty (high, low, disturbance) • Loss of 12-volt power • Power supply faulty (high, low, disturbance)
	(2) External disturbances • EMI or ESD • Single event effects (e.g., cosmic rays, protons) • Vibration or shock impact • Manufacturing defects and assembly problems • Extreme external temperature or thermal cycling • Moisture, corrosion, or contamination • Organic growth • Physical interference (e.g., chafing)

<table>
<tr><td rowspan="5">Sensor</td><td>(4) Hazardous interaction with other components in the rest of the vehicle
• EMI or ESD
• Vibration or shock impact
• Physical interference (e.g., chafing)
• Moisture, corrosion, or contamination
• Excessive heat from other components
• Electrical arcing from neighboring components or exposed terminals
• Corona effects from high voltage components</td></tr>
<tr><td>(9) Sensor inadequate operation, change over time
• Internal hardware failure
• Overheating due to increased resistance in a subcomponent or internal shorting
• Degradation over time
• Over temperature due to faulty cooling system
• Reporting frequency too low</td></tr>
<tr><td>(3) Power supply faulty (high, low, disturbance)
• Loss of 12-volt power
• Reference voltage incorrect (e.g., too low, too high)
• Power supply faulty (high, low, disturbance)</td></tr>
<tr><td>(2) External disturbances
• EMI or ESD
• Single event effects (e.g., cosmic rays, protons)
• Vibration or shock impact
• Manufacturing defects and assembly problems
• Extreme external temperature or thermal cycling
• Moisture, corrosion, or contamination
• Organic growth
• Physical interference (e.g., chafing)
• Magnetic interference</td></tr>
<tr><td>(4) Hazardous interaction with other components in the rest of the vehicle
• EMI or ESD
• Vibration or shock impact
• Physical interference (e.g., chafing)
• Moisture, corrosion, or contamination
• Excessive heat from other components
• Magnetic interference
• Electrical arcing from neighboring components or exposed terminals
• Corona effects from high voltage components</td></tr>
</table>

Actuator	(15) Actuator inadequate operation, change over time • Internal hardware failure • Degradation over time • Over temperature due to faulty cooling system • Incorrectly sized actuator • Relay failure modes, including: 1) does not energize, 2) does not de-energize, and 3) welded contacts • Overheating due to increased resistance in a subcomponent or internal shorting
	(3) Power supply faulty (high, low, disturbance) • Loss of 12-volt power • Power supply faulty (high, low, disturbance)
	(2) External disturbances • EMI or ESD • Single event effects (e.g., cosmic rays, protons) • Vibration or shock impact • Manufacturing defects and assembly problems • Extreme external temperature or thermal cycling • Moisture, corrosion, or contamination • Organic growth • Physical interference (e.g., chafing) • Magnetic interference
	(4) Hazardous interaction with other components in the rest of the vehicle • EMI or ESD • Vibration or shock impact • Physical interference (e.g., chafing) • Moisture, corrosion, or contamination • Excessive heat from other components • Magnetic interference • Electrical arcing from neighboring components or exposed terminals • Corona effects from high voltage components • Unable to meet demands from multiple components (e.g., inadequate torque)
Controlled Process	**(20) Controlled component failure, change over time** • Internal hardware failure • Degradation over time
	(3) Power supply faulty (high, low, disturbance) • Loss of 12-volt power • Power supply faulty (high, low, disturbance)

Controlled Process	(2) External disturbances • EMI or ESD • Single event effects (e.g., cosmic rays, protons) • Vibration or shock impact • Manufacturing defects and assembly problems • Extreme external temperature or thermal cycling • Moisture, corrosion, or contamination • Organic growth • Physical interference (e.g., chafing) • Magnetic interference
	(4) Hazardous interaction with other components in the rest of the vehicle • EMI or ESD • Vibration or shock impact • Physical interference (e.g., chafing) • Moisture, corrosion, or contamination • Excessive heat from other components • Magnetic interference • Electrical arcing from neighboring components or exposed terminals • Corona effects from high voltage components • Unable to meet demands from multiple components (e.g., inadequate torque)
	(22) Output of controlled process contributing to system hazard
Process Input Supplier to Controlled Process	**(23) Process input supplier inadequate operation, change over time** • Process input supplier inadequate operation, change over time • Electrical noise other than EMI or ESD
	(3) Power supply faulty (high, low, disturbance) • Loss of 12-volt power • Power supply faulty (high, low, disturbance)
	(2) External disturbances • EMI or ESD • Single event effects (e.g., cosmic rays, protons) • Vibration or shock impact • Manufacturing defects and assembly problems • Extreme external temperature or thermal cycling • Moisture, corrosion, or contamination • Organic growth • Physical interference (e.g., chafing) • Magnetic interference

	(4) Hazardous interaction with other components in the rest of the vehicle • EMI or ESD • Vibration or shock impact • Physical interference (e.g., chafing) • Moisture, corrosion, or contamination • Excessive heat from other components • Magnetic interference • Electrical arcing from neighboring components or exposed terminals • Corona effects from high voltage components • Unable to meet demands from multiple components (e.g., inadequate torque)
Connections	
Sensor to Controller, Controller to Actuator	**(10) and (16) Hardware open, short, missing, intermittent faulty** • Connection is intermittent • Connection is open, short to ground, short to battery, or short to other wires in harness • Electrical noise other than EMI or ESD • Connector contact resistance is too high • Connector shorting between neighboring pins • Connector resistive drift between neighboring pins **(11) and (17) Communication bus error** • Bus overload or bus error • Signal priority too low • Failure of the message generator, transmitter, or receiver • Malicious intruder **(24) and (25) Incorrect connection** • Incorrect wiring connection • Incorrect pin assignment **(2) External disturbances** • EMI or ESD • Single event effects (e.g., cosmic rays, protons) • Vibration or shock impact • Manufacturing defects and assembly problems • Extreme external temperature or thermal cycling • Unused connection terminals affected by moisture, corrosion, or contamination

- Organic growth
- Physical interference (e.g., chafing)
- Active connection terminals affected by moisture, corrosion, or contamination

	(4) Hazardous interaction with other components in the rest of the vehicle • EMI or ESD • Vibration or shock impact • Physical interference (e.g., chafing) • Unused connection terminals affected by moisture, corrosion, or contamination • Excessive heat from other components • Electrical arcing from neighboring components or exposed terminals • Corona effects from high voltage components • Active connection terminals affected by moisture, corrosion, or contamination • Mechanical connections affected by moisture, corrosion, or contamination
Actuator to Controlled Process	**(18) Actuation delivered incorrectly or inadequately: Hardware faulty**
	(19) Actuation delayed
	(20) Actuator to controlled process incorrect connection
	(2) External disturbances • EMI or ESD • Single event effects (e.g., cosmic rays, protons) • Vibration or shock impact • Manufacturing defects and assembly problems • Extreme external temperature or thermal cycling • Unused connection terminals affected by moisture, corrosion, or contamination • Organic growth • Physical interference (e.g., chafing) • Active connection terminals affected by moisture, corrosion, or contamination • Mechanical connections affected by moisture, corrosion, or contamination
	(4) Hazardous interaction with other components in the rest of the vehicle • EMI or ESD • Vibration or shock impact • Physical interference (e.g., chafing) • Unused connection terminals affected by moisture, corrosion, or contamination • Excessive heat from other components • Electrical arcing from neighboring components or exposed terminals • Corona effects from high voltage components • Active connection terminals affected by moisture, corrosion, or contamination • Mechanical connections affected by moisture, corrosion, or contamination

Controlled Process to Sensor	(12) Sensor measurement incorrect or missing
	Sensor incorrectly aligned/positioned
	(13) Sensor measurement inaccurate
	Sensor incorrectly aligned/positioned
	(14) Sensor measurement delay
	Sensor incorrectly aligned/positioned
	(2) External disturbances
	• EMI or ESD • Single event effects (e.g., cosmic rays, protons) • Vibration or shock impact • Manufacturing defects and assembly problems • Extreme external temperature or thermal cycling • Unused connection terminals affected by moisture, corrosion, or contamination • Organic growth • Physical interference (e.g., chafing) • Active connection terminals affected by moisture, corrosion, or contamination • Mechanical connections affected by moisture, corrosion, or contamination
	(4) Hazardous interaction with other components in the rest of the vehicle
	• EMI or ESD • Vibration or shock impact • Physical interference (e.g., chafing) • Unused connection terminals affected by moisture, corrosion, or contamination • Excessive heat from other components • Electrical arcing from neighboring components or exposed terminals • Corona effects from high voltage components • Active connection terminals affected by moisture, corrosion, or contamination • Mechanical connections affected by moisture, corrosion, or contamination
Other Controller to Controlled Process	**(5) Conflicting control action**
Process Input Supplier to Controlled Process	**(21) Input to controlled process missing or wrong**

APPENDIX C: HAZOP STUDY RESULTS

Table C- 1. Function 1: Control brake fluid pressure to prevent vehicle wheels from locking-up under braking for the vehicle to remain steerable in ABS events

I.D.	***Malfunction***	***Potential Vehicle Level Hazard***
F1-1	Does not control brake fluid pressure to prevent lock-up and loss of steerability in ABS events	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw Insufficient Vehicle Deceleration Loss of Lateral Motion Control
F1-2	Excessively controls pressure (i.e., over-"corrects" pressure, reducing braking force more than necessary or when unnecessary or when no longer necessary to maintain steerability) in ABS events	Insufficient Vehicle Deceleration
F1-3	Insufficiently or intermittently controls pressure (i.e., under-"corrects" pressure, resulting in lock-up and loss of steerability) in ABS events	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw Insufficient Vehicle Deceleration Loss of Lateral Motion Control
F1-4	Controls brake fluid pressure too early in ABS events	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw Insufficient Vehicle Deceleration Loss of Lateral Motion Control
F1-5	Controls brake fluid pressure too late in ABS events	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw Insufficient Vehicle Deceleration
F1-6	Controls brake fluid pressure in wrong direction (i.e., increases brake pressure when Steerability requires it be reduced) in ABS events	Unintended Vehicle Deceleration Unintended Vehicle Lateral Motion / Unintended Yaw
F1-7	Controls brake fluid pressure as in response to an ABS event when the action is not requested and/or necessary	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw Insufficient Vehicle Deceleration Loss of Lateral Motion Control
F1-8	Brake fluid pressure is controlled even after request for braking is removed	Insufficient Vehicle Deceleration

Table C-2. Function 2: Provide selective wheel braking in support of Traction Control System

I.D.	***Malfunction***	***Potential Vehicle Level Hazard***
F2-1	Does not control drive wheel brake fluid pressure to prevent spinning during a TCS event	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw
F2-2	Controls brake fluid pressure to wrong wheel (i.e., reduces spinning and torque to wrong drive wheel) during a TCS event	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw
F2-3	Controls brake fluid pressure too much (i.e., provides too much torque reduction and/or reduces wheel rotation too much on targeted drivewheel) during a TCS event	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw
F2-4	Controls brake pressure insufficiently or intermittently (i.e., provides too little torque reduction and reduces wheel rotation too little on targeted drivewheel) during a TCS event	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw
F2-5	Controls brake fluid pressure too early during a TCS event	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw
F2-6	Controls brake fluid pressure too late during a TCS event	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw
F2-7	Controls brake fluid pressure as in response to a TCS event when the action is not requested and/or necessary	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw
F2-8	Controls brake fluid pressure at a constant value even as control needs are varying higher or lower than the stuck value	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw

Table C-3. Function 3: Control brake fluid pressure to each wheel to provide vehicle control during extreme dynamic maneuvers, in adverse conditions, or other ESC event

I.D.	***Malfunction***	***Potential Vehicle Level Hazard***
F3-1	Does not control brake fluid pressure to provide vehicle control during extreme dynamic maneuvers, in adverse conditions, or other ESC event	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw
F3-2	Controls brake fluid pressure to wrong wheel or decreases pressure when it should be increased (or vice versa) during extreme dynamic maneuvers, in adverse conditions, or other ESC event	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw
F3-3	Controls brake fluid pressure too much (i.e., applies too much pressure) during extreme dynamic maneuvers, in adverse conditions, or other ESC event	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw Unintended Vehicle Deceleration
F3-4	Controls brake fluid pressure insufficiently or intermittently (i.e., applies too little pressure) during extreme dynamic maneuvers, in adverse conditions, or other ESC event	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw
F3-5	Controls brake fluid pressure too early during extreme dynamic maneuvers, in adverse conditions, or other ESC event	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw
F3-6	Controls brake fluid pressure too late during extreme dynamic maneuvers, in adverse conditions, or other ESC event	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw
F3-7	Controls brake fluid pressure as in response to extreme dynamic maneuvers, in adverse conditions, or other ESC event when the action is not requested and/or necessary	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw
F3-8	During a braking event, brake fluid pressure becomes stuck at one value rather than varying depending on the controls algorithm.	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw

Table C-4. Function 4: Provide overdamped (non-oscillatory) brake torque in response to driver operated control consistent with FMVSS 135 and other applicable standards

I.D.	***Malfunction***	***Potential Vehicle Level Hazard***
F4-1	Does not provide brake force in response to driver operated control within TBD time	Insufficient Vehicle Deceleration
F4-2	Does not provide brake force (loss of braking)	Insufficient Vehicle Deceleration
F4-3	Provides too much brake force in response to driver operated control within TBD time	Unintended Vehicle Deceleration
F4-4	Provides insufficient or intermittent brake force in response to driver operated control within TBD time	Insufficient Vehicle Deceleration
F4-5	Provides brake force too early in response to driver operated control within TBD time	Unintended Vehicle Deceleration
F4-6	Provides brake force too late in response to driver operated control within TBD time	Insufficient Vehicle Deceleration
F4-7	Provides brake force as if in response to driver operated control within TBD time when the action is not requested and/or necessary	Unintended Vehicle Deceleration
F4-8	Provides brake force for too long, even after the driver has stopped requesting any braking through the brake pedal	Unintended Vehicle Deceleration

Table C-5. Function 5: Implement braking function to support other systems

I.D.	***Malfunction***	***Potential Vehicle Level Hazard***
F5-1	Does not implement braking commands requested by other vehicle systems	Insufficient Vehicle Deceleration
F5-2	Implements excessive braking commands (i.e., too much braking force compared to what is requested by other vehicle systems)	Unintended Vehicle Deceleration
F5-3	Implements insufficient or intermittent braking commands (i.e., too little braking force compared to what is requested by other vehicle systems)	Insufficient Vehicle Deceleration
F5-4	Implements unchanging (stuck) braking commands (e.g., too little braking force) requested by other vehicle systems	Insufficient Vehicle Deceleration Unintended Vehicle Deceleration
F5-5	Implements braking commands requested by other vehicle systems too early	Unintended Vehicle Deceleration
F5-6	Implements braking commands requested by other vehicle systems too late	Insufficient Vehicle Deceleration
F5-7	Implements braking commands as if requested by other vehicle systems when not actually requested	Unintended Vehicle Deceleration

Table C-6. Function 6: Provide brake force for other internal brake system features

I.D.	***Malfunction***	***Potential Vehicle Level Hazard***
F6-1	Does not provide brake force for other internal brake system features (e.g. Hill Hold System)	Insufficient Vehicle Deceleration Vehicle Motion in Unexpected Direction
F6-2	Provides excessive braking force for other internal brake system features (e.g. Hill Hold System)	Unintended Vehicle Deceleration
F6-3	Provides intermittent or insufficient braking force for other internal brake system features (e.g. Hill Hold System)	Vehicle Motion in Unexpected Direction Insufficient Vehicle Deceleration
F6-4	Provides unchanging (stuck) braking force for other internal brake system features (e.g. Hill Hold System)	Insufficient Vehicle Deceleration Unintended Vehicle Deceleration
F6-5	Provides braking force for other internal brake system features (e.g. Hill Hold System) too early	Unintended Vehicle Deceleration
F6-6	Provides braking force for other internal brake system features (e.g. Hill Hold System) too late	Vehicle Motion in Unexpected Direction Insufficient Vehicle Deceleration
F6-7	Provides braking force for other internal brake system features (e.g. Hill Hold System) when not actually requested	Unintended Vehicle Deceleration

Table C-7. Function 7: Coordinate yaw rate stabilization with steering system and other vehicle systems

I.D.	*Malfunction*	*Potential Vehicle Level Hazard*
F7-1	Does not request steering adjustment from steering system	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw Insufficient Vehicle Deceleration
F7-2	Requests excessive steering adjustment from steering system	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw
F7-3	Requests insufficient or intermittent steering adjustment from steering system	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw
F7-4	Requests unchanging (stuck) steering adjustment from steering system	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw
F7-5	Requests steering adjustment from steering system too early	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw
F7-6	Requests steering adjustment from steering system too late	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw
F7-7	Requests steering adjustment from steering system when no steering adjustment is required	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw

Table C-8. Function 8: Provide driver with feedback about system states

I.D.	*Malfunction*	*Potential Vehicle Level Hazard*
F8-1	System does not provide driver with feedback	Loss of Lateral Motion Control Loss of Longitudinal Motion Control
F8-2	System provides driver with feedback too early	None
F8-3	System provides driver with feedback too late	Loss of Lateral Motion Control Loss of Longitudinal Motion Control
F8-4	System provides driver with intermittent feedback	Loss of Lateral Motion Control Loss of Longitudinal Motion Control
F8-5	System provides driver with too little feedback	Loss of Lateral Motion Control Loss of Longitudinal Motion Control
F8-6	System provides driver with too much feedback	None
F8-7	System provides driver with unchanging (stuck) feedback	Loss of Lateral Motion Control Loss of Longitudinal Motion Control
F8-8	System provides driver with incorrect feedback	Loss of Lateral Motion Control Loss of Longitudinal Motion Control
F8-9	System provides driver with feedback when no feedback is required	None

Table C-9. Function 9: Disengage ABS, TCS, and/or ESC when not functioning properly

I.D.	***Malfunction***	***Potential Vehicle Level Hazard***
F9-1	System does not disengage ABS, TCS, and/or ESC when not functioning properly	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw Insufficient Vehicle Deceleration Unintended Vehicle Deceleration
F9-2	System disengages ABS, TCS, and/or ESC (when not functioning properly) too early	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw Insufficient Vehicle Deceleration Unintended Vehicle Deceleration
F9-3	System disengages ABS, TCS, and/or ESC (when not functioning properly) too late	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw Insufficient Vehicle Deceleration Unintended Vehicle Deceleration
F9-4	System incorrectly disengages ABS, TCS, and/or ESC (when not functioning properly)	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw Insufficient Vehicle Deceleration Unintended Vehicle Deceleration
F9-5	System disengages ABS, TCS, and/or ESC when disengagement not required	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw Insufficient Vehicle Deceleration Unintended Vehicle Deceleration

Table C-10. Function 10: Stores relevant data

I.D.	***Malfunction***	***Potential Vehicle Level Hazard***
F10-1	System does not store data	None
F10-2	System stores too much data	None
F10-3	System stores too little data	None
F10-4	System stores data intermittently	None
F10-5	System stores same data (stuck value)	None

Table C-11. Function 11: Provides diagnostics

I.D.	*Malfunction*	*Potential Vehicle Level Hazard*
F11-1	System does not perform diagnostics	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw Insufficient Vehicle Deceleration Unintended Vehicle Deceleration
F11-2	System performs diagnostics incorrectly	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw Insufficient Vehicle Deceleration Unintended Vehicle Deceleration
F11-3	System performs diagnostics intermittently	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw Insufficient Vehicle Deceleration Unintended Vehicle Deceleration

Table C-12. Function 12: Communicates with internal subsystems and external vehicle systems

I.D.	*Malfunction*	*Potential Vehicle Level Hazard*
F12-1	System does not communicate	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw Unintended Vehicle Deceleration Insufficient Vehicle Deceleration
F12-2	System communicates incorrectly	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw Unintended Vehicle Deceleration Insufficient Vehicle Deceleration
F12-3	System communicates intermittently	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw Loss of Lateral Motion Control Unintended Vehicle Deceleration Insufficient Vehicle Deceleration
F12-4	System communicates same data (stuck value)	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw Unintended Vehicle Deceleration Insufficient Vehicle Deceleration

Table C-13. Function 13: Provides fault detection and failure mitigation

I.D.	***Malfunction***	***Potential Vehicle Level Hazard***
F13-1	System does not provide fault detection and failure mitigation	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw Unintended Vehicle Deceleration Insufficient Vehicle Deceleration
F13-2	System provides fault detection and failure mitigation incorrectly	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw Unintended Vehicle Deceleration Insufficient Vehicle Deceleration
F13-3	System provides fault detection and failure mitigation too early	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw Unintended Vehicle Deceleration Insufficient Vehicle Deceleration
F13-4	System provides fault detection and failure mitigation too late	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw Unintended Vehicle Deceleration Insufficient Vehicle Deceleration
F13-5	System provides fault detection and failure mitigation intermittently	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw Unintended Vehicle Deceleration Insufficient Vehicle Deceleration
F13-6	System provides the same fault detection and failure mitigation (stuck value)	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw Unintended Vehicle Deceleration Insufficient Vehicle Deceleration

Table C- 14. Function 14: Provide overdamped (non-oscillatory) release of brake torque in response to driver operated control

I.D.	*Malfunction*	*Potential Vehicle Level Hazard*
F14-1	Brakes would remain engaged when driver is not trying to slow down	Unintended Vehicle Deceleration
F14-2	Brakes release is so quickly that only a slight lifting of the brake pedal releases brakes much more than expected	Insufficient Vehicle Deceleration
F14-3	Brakes release is so slowly that even when the brake pedal is completely released, vehicle may still be braking for some period of time	Unintended Vehicle Deceleration
F14-4	Brakes are released and then applied again causing significant vehicle jerk	Unintended Vehicle Deceleration Insufficient Vehicle Deceleration
F14-5	Brakes release before driver requests them to release resulting in insufficient braking	Insufficient Vehicle Deceleration
F14-6	Brakes release after driver requests them to release resulting in over-braking	Unintended Vehicle Deceleration
F14-7	Pedal release results in unexpectedly more braking	Unintended Vehicle Deceleration
F14-8	The brake release function permanently remains released despite subsequent brake applications	Insufficient Vehicle Deceleration Loss of Longitudinal Motion Control
F14-9	During a braking event, brakes unexpectedly release resulting in continuing vehicle motion driver didn't request	Unintended Vehicle Deceleration

Table C-15. Function 15: Provide redundancy and/or backup braking consistent with FMVSS 135 and ECE REG 13-H

I.D.	***Malfunction***	***Potential Vehicle Level Hazard***
F15-1	Loss of redundancy still results in a vehicle capable of braking, but susceptible to a single point failure	Insufficient Vehicle Deceleration
F15-2	A limping backup system could result in longer stopping distances should the primary system fail	Insufficient Vehicle Deceleration
F15-3	A backup system not available at all times coupled with a single point failure in the primary system could result in longer stopping distances	Insufficient Vehicle Deceleration
F15-4	Unintended braking with redundant system acting too early	Unintended Vehicle Deceleration
F15-5	Late application of redundant system in the case of a failed primary system could result in longer stopping distances	Insufficient Vehicle Deceleration
F15-6	If either the primary or redundant system applies when not requested, could result in unintended deceleration or vehicle instability	Unintended Vehicle Deceleration Unintended Vehicle Lateral Motion / Unintended Yaw
F15-7	If either the primary or redundant system applies when not requested, could result in unintended deceleration or vehicle instability	Unintended Vehicle Deceleration Unintended Vehicle Lateral Motion / Unintended Yaw

Table C-16. Function 16: For same degree of pedal depression, brake force is greater than drive force

I.D.	*Malfunction*	*Potential Vehicle Level Hazard*
F16-1	Accelerator pedal requests more torque than brake pedal resulting in unintended acceleration	Unintended Vehicle Propulsion
F16-2	More braking force than accelerator force than intended within this arbitration function results in stronger braking than needed	None
F16-3	Accelerator pedal requests more torque than brake pedal resulting in unintended acceleration	Unintended Vehicle Propulsion
F16-4	Brake override of accelerator intermittently results in vehicle jerk combined with unintended acceleration	Unintended Vehicle Propulsion Unintended Vehicle Deceleration
F16-5	Earlier braking force that is greater than accelerator force than intended within this arbitration function results in stronger braking than needed	Unintended Vehicle Deceleration
F16-6	Late extra braking force to counteract acceleration force could result in short term unintended acceleration	Unintended Vehicle Propulsion
F16-7	Accelerator pedal requests more torque than brake pedal resulting in unintended acceleration	Unintended Vehicle Propulsion
F16-8	Accelerator pedal requests more torque than brake pedal resulting in unintended acceleration	Unintended Vehicle Propulsion
F16-9	If arbitrating controller or hardware chooses more braking over acceleration without an actual issue, unintended braking results	Unintended Vehicle Deceleration

Table C-17. Function 17: Proportion brake force between front and rear wheels to maximize braking function

I.D.	***Malfunction***	***Potential Vehicle Level Hazard***
F17-1	Rear wheel lockup in worst case, rear wheel anti-lock braking in best case without F/R proportioning on a moderate to hard braking event	Unintended Vehicle Lateral Motion / Unintended Yaw Loss of Lateral Motion Control Insufficient Vehicle Deceleration
F17-2	More force proportioned to front would result in less deceleration than expected in moderate to hard braking events coupled with potential for front wheel lockup/ABS (vehicle stable, but not easily controllable)	Insufficient Vehicle Lateral Motion / Insufficient Yaw Insufficient Vehicle Deceleration
F17-3	Less force proportioned to front would result in less deceleration than expected in moderate to hard braking events coupled with potential for rear wheel lockup/ABS (vehicle not likely stable, and not easily controllable)	Unintended Vehicle Lateral Motion / Unintended Yaw Loss of Lateral Motion Control Insufficient Vehicle Deceleration
F17-4	Intermittent proportioning results in unpredictable wheel lockups followed by release, possibly quicker than ABS controller and hardware can react	Insufficient Vehicle Deceleration
F17-5	Proportioning earlier than a brake request results in unintended braking	Unintended Vehicle Deceleration
F17-6	Proportioning later than shift in tire patch normal forces could result in rear wheel lockup/ABS for a short period of time until proportioning catches up	Unintended Vehicle Lateral Motion / Unintended Yaw Loss of Lateral Motion Control Insufficient Vehicle Deceleration
F17-7	Inadvertent proportioning toward the rear could result in rear wheel lockup/ABS followed by vehicle not likely stable and not easily controllable	Unintended Vehicle Lateral Motion / Unintended Yaw Loss of Lateral Motion Control Insufficient Vehicle Deceleration
F17-8	Locked proportioning outside of a brake event would be unintended braking	Unintended Vehicle Lateral Motion / Unintended Yaw Loss of Lateral Motion Control Unintended Vehicle Deceleration
F17-9	Proportioning outside of a brake event would be unintended braking	Unintended Vehicle Lateral Motion / Unintended Yaw Loss of Lateral Motion Control Unintended Vehicle Deceleration

Table C-18. Function 18: Proportion brake force between left and right wheels to maximize braking function

I.D.	***Malfunction***	***Potential Vehicle Level Hazard***
F18-1	No proportioning to left or right coupled with uneven weight distribution could result in vehicle pulling (steering) to one direction while braking and/or wheel lockup/ABS on side with less weight	Unintended Vehicle Lateral Motion / Unintended Yaw Insufficient Vehicle Lateral Motion / Insufficient Yaw
F18-2	Proportioning too much to the weighted side would not maximize braking resulting in longer stopping distances	Unintended Vehicle Lateral Motion / Unintended Yaw Loss of Lateral Motion Control Insufficient Vehicle Deceleration
F18-3	Proportioning too little to the weighted side could result in wheel lockup/ABS on side with less weight	Unintended Vehicle Lateral Motion / Unintended Yaw Loss of Lateral Motion Control Insufficient Vehicle Deceleration
F18-4	Intermittent side-to-side proportioning could result in a vehicle that switches between pulling/jerking to one side, braking normally, and locking/ABS on a wheel or side	Unintended Vehicle Lateral Motion / Unintended Yaw Loss of Lateral Motion Control Insufficient Vehicle Deceleration
F18-5	Side-to-side proportioning too early may result in unintended braking	Insufficient Vehicle Deceleration
F18-6	Side-to-side proportioning too late may result in wheel lockup/ABS followed by a more optimal braking event	Unintended Vehicle Lateral Motion / Unintended Yaw Loss of Lateral Motion Control Insufficient Vehicle Deceleration
F18-7	Proportioning to the less weighted side could result in wheel lockup/ABS on that lighter side	Unintended Vehicle Lateral Motion / Unintended Yaw Loss of Lateral Motion Control Insufficient Vehicle Deceleration
F18-8	Locked proportioning outside of a brake event would be unintended braking	Unintended Vehicle Deceleration
F18-9	Proportioning outside of a brake event would be unintended braking	Unintended Vehicle Deceleration

Table C-19. Function 19: Request a reduction in propulsion/throttle from the ACS/ETC when needed to support a TCS or ESC event

I.D.	***Malfunction***	***Potential Vehicle Level Hazard***
F19-1	Wheel braking against unreduced propulsion torque	Loss of Lateral Motion Control Unintended Vehicle Deceleration Unintended Vehicle Propulsion
F19-2	Excess wheel braking from lower-than-expected propulsion torque	Unintended Vehicle Deceleration Insufficient Vehicle Propulsion
F19-3	Insufficient wheel braking from higher-than-expected propulsion torque	Insufficient Vehicle Deceleration
F19-6	Oscillatory brake force from unexpectedly varying propulsion torque	Loss of Lateral Motion Control Unintended Vehicle Deceleration
F19-7	Wheel slip is reduced more quickly than expected	None
F19-8	Wheel slip is reduced more slowly than expected	Loss of Lateral Motion Control
F19-9	Wheel braking against increasing propulsion torque (up to max torque)	Unintended Vehicle Propulsion

Table C-20. Function 20: Request an increase in torque from the ACS/ETC to prevent wheel lock during sudden deceleration

I.D.	***Malfunction***	***Potential Vehicle Level Hazard***
F20-1	No torque increase requested resulting in sustained sudden deceleration	Unintended Vehicle Deceleration
F20-2	Torque increase request higher than needed resulting in net acceleration	Unintended Vehicle Propulsion
F20-3	Torque increase request lower than needed resulting in only slightly mitigated sudden deceleration	Unintended Vehicle Deceleration
F20-4	Oscillatory torque increase along with sudden deceleration forces results in significant forward/backward vehicle jerk	Unintended Vehicle Deceleration Unintended Vehicle Propulsion
F20-5	Torque first increases resulting in acceleration that is soon shifted to a mitigated sudden deceleration event	Unintended Vehicle Deceleration Unintended Vehicle Propulsion
F20-6	Initial sudden deceleration occurs longer than expected before finally vehicle returns to the neutral position of a mitigated event	Unintended Vehicle Deceleration
F20-7	Drive torque is requested down to zero resulting in maximizing the jerk form the sudden deceleration event	Unintended Vehicle Deceleration
F20-8	Constant request for propulsion torque outside of a sudden deceleration event could result in unintended acceleration	Unintended Vehicle Propulsion
F20-9	Request for propulsion torque outside of a sudden deceleration event could result in unintended acceleration	Unintended Vehicle Propulsion

Table C-21. Function 21: Provide a maximum braking torque of TBD Nm with a maximum brake application force of TBD N from the driver

I.D.	***Malfunction***	***Potential Vehicle Level Hazard***
F21-1	Driver required to push much harder on brake pedal for same braking force	Insufficient Vehicle Deceleration
F21-2	Small driver brake pedal application results in large braking force (unintended braking from "touchy" brakes)	Unintended Vehicle Deceleration
F21-3	Large driver brake pedal application results in small braking force (insufficient braking)	Insufficient Vehicle Deceleration
F21-4	Intermittent boost could result in wheel lockup when driver applies brakes without boost at a given force, then when boost returns a step function of force is applied to all four wheels	Unintended Vehicle Deceleration Loss of Lateral Motion Control
F21-5	Early boost could result in unintended braking	Insufficient Vehicle Deceleration
F21-6	Late boost could result in wheel lockup when driver applies brakes without boost at a given force, then when boost returns a step function of force is applied to all four wheels	Unintended Vehicle Deceleration Loss of Lateral Motion Control
F21-7	Boost applied in opposition to driver pedal force results in a vehicle effectively without brakes	Insufficient Vehicle Deceleration Loss of Longitudinal Motion Control
F21-8	If constant, stuck boost results in brake application without driver request, could result in vehicle unable to move	Unintended Vehicle Deceleration Loss of Longitudinal Motion Control
F21-9	If boost results in brake application provided when not requested, could result in vehicle unable to move	Unintended Vehicle Deceleration Loss of Longitudinal Motion Control

Table C-22. Function 22: Measure and provide the vehicle speed based on available sensors and models

I.D.	***Malfunction***	***Potential Vehicle Level Hazard***
F22-1	Loss of vehicle speed cascades to loss of ABS, TCS, ESC, as well as other dependent subsystems outside of the brake system	Unintended Vehicle Lateral Motion / Unintended Yaw Unintended Vehicle Propulsion Unintended Vehicle Deceleration Insufficient Vehicle Deceleration
F22-2	Measured/modeled speed > actual speed, ABS/TCS/ESC applied more aggressively than needed	Loss of Lateral Motion Control Unintended Vehicle Deceleration
F22-3	Measured/modeled speed < actual speed, ABS/TCS/ESC applied less aggressively than needed	Loss of Lateral Motion Control Insufficient Vehicle Deceleration
F22-4	ABS/TCS/ESC potentially disabled due to lack of trust of sensors and/or model	Unintended Vehicle Lateral Motion / Unintended Yaw Unintended Vehicle Propulsion Unintended Vehicle Deceleration Insufficient Vehicle Deceleration
F22-5	With an offset in speed measurement in magnitude or time, ABS/TCS/ESC behavior could become unpredictable with unexpected vehicle jerk along with stability/controllability issues	Unintended Vehicle Lateral Motion / Unintended Yaw Unintended Vehicle Propulsion Unintended Vehicle Deceleration Insufficient Vehicle Deceleration
F22-6	Measured/modeled speed decreasing while actual speed increasing could result in insufficient braking or other unpredictable results within the ABS/TCS/ESC systems	Loss of Lateral Motion Control Insufficient Vehicle Deceleration
F22-7	Stuck at 0mph when vehicle is >0mph could effectively disable ABS/TCS/ESC when it would be needed	Unintended Vehicle Lateral Motion / Unintended Yaw Unintended Vehicle Propulsion Unintended Vehicle Deceleration Insufficient Vehicle Deceleration

Table C-23. Function 23: For all positions of accelerator pedal and all resulting engine speeds/transmission operating points, an attainable brake pedal position exists where brake force is greater than drive force

I.D.	***Malfunction***	***Potential Vehicle Level Hazard***
F23-1	Any situation where brake torque cannot overpower engine torque, unintended acceleration results	Unintended Vehicle Propulsion
F23-2	More brake torque than intended only serves to provide margin against the propulsion torque	None
F23-3	Any situation where brake torque cannot overpower engine torque, unintended acceleration results	Unintended Vehicle Propulsion
F23-4	Any situation where brake torque cannot overpower engine torque, unintended acceleration results	Unintended Vehicle Propulsion
F23-5	Brake torque applied earlier than desired against a propulsion torque could leave to unintended braking for a brief period	Unintended Vehicle Deceleration
F23-6	Any situation where brake torque cannot overpower engine torque, unintended acceleration results	Unintended Vehicle Propulsion
F23-7	Any situation where brake torque cannot overpower engine torque, unintended acceleration results	Unintended Vehicle Propulsion
F23-8	Higher brake torque than propulsion torque held beyond the necessary time would result in a vehicle that won't move	None
F23-9	Unintended braking	Unintended Vehicle Deceleration

APPENDIX D: UNSAFE CONTROL ACTION (UCA) ASSESSMENT TABLES

Table D- 1: Control Action: "Allow Hydraulic Pressure to Increase at Individual Wheel for ABS Function"

Context Variables (Allow Hydraulic Pressure to Increase at Individual Wheel for ABS Function)			**Guidewords for Assessing Whether the Control Action May Be Unsafe**								
Mu-Slip Curve Region	Driver's Braking Command	Other Vehicle Systems' or Internal Brake System Functions Braking Request	Not provided in this context	Provided in this context	Provided, but duration is too long	Provided, but duration is too short	Provided, but the intensity is incorrect (too much)	Provided, but the intensity is incorrect (too little)	Provided, but executed incorrectly	Provided, but the starting time is too soon	Provided, but the starting time is too late
Stable Region	Brake Applied	No Braking	H6	Not Hazardous	H2, H6, H3	H1, H2, H6	N/A	N/A	H1, H2, H6, H3	N/A	H1, H2, H6
Stable Region	Brake Applied	Increase Braking Force to Wheel	H6	Not Hazardous	H2, H6, H3	H1, H2, H6	N/A	N/A	H1, H2, H6, H3	N/A	H1, H2, H6
Stable Region	Brake Applied	Decrease Braking Force to Wheel	H6	H1B, H2B, H4B	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Stable Region	Brake Applied	Increase and Decrease Braking Force to Wheel	H6	H1B, H2B, H4B	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Stable Region	Brake Not Applied	No Braking	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous
Stable Region	Brake Not Applied	Increase Braking Force to Wheel	H6	Not Hazardous	H2, H6, H3	H1, H2, H6	N/A	N/A	H1, H2, H6, H3	N/A	H1, H2, H6
Stable Region	Brake Not Applied	Decrease Braking Force to Wheel	Not hazardous	H1, H2, H4	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Stable Region	Brake Not Applied	Increase and Decrease Braking Force to Wheel	H6	H1B, H2B, H4B	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided

Context Variables (Allow Hydraulic Pressure to Increase at Individual Wheel for ABS Function)			Guidewords for Assessing Whether the Control Action May Be Unsafe								
Mu-Slip Curve Region	Driver's Braking Command	Other Vehicle Systems' or Internal Brake System Functions Braking Request	Not provided in this context	Provided in this context	Provided, but duration is too long	Provided, but duration is too short	Provided, but the intensity is incorrect (too much)	Provided, but the intensity is incorrect (too little)	Provided, but executed incorrectly	Provided, but the starting time is too soon	Provided, but the starting time is too late
Peak	Brake Applied	No Braking	Not hazardous	H2, H6, H3	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Peak	Brake Applied	Increase Braking Force to Wheel	Not hazardous	H2, H6, H3	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Peak	Brake Applied	Decrease Braking Force to Wheel	Not hazardous	H2, H6, H3	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Peak	Brake Applied	Increase and Decrease Braking Force to Wheel	Not hazardous	H2, H6, H3	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Peak	Brake Not Applied	No Braking	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous
Peak	Brake Not Applied	Increase Braking Force to Wheel	Not hazardous	H2, H6, H3	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Peak	Brake Not Applied	Decrease Braking Force to Wheel	Not hazardous	H2, H6, H3	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Peak	Brake Not Applied	Increase and Decrease Braking Force to Wheel	Not hazardous	H2, H6, H3	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Unstable Region (Tb > Tr)	Brake Applied	No Braking	Not hazardous	H2, H6, H3	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Unstable Region (Tb > Tr)	Brake Applied	Increase Braking Force to Wheel	Not hazardous	H2, H6, H3	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided

Context Variables (Allow Hydraulic Pressure to Increase at Individual Wheel for ABS Function)			**Guidewords for Assessing Whether the Control Action May Be Unsafe**								
Mu-Slip Curve Region	Driver's Braking Command	Other Vehicle Systems' or Internal Brake System Functions Braking Request	Not provided in this context	Provided in this context	Provided, but duration is too long	Provided, but duration is too short	Provided, but the intensity is incorrect (too much)	Provided, but the intensity is incorrect (too little)	Provided, but executed incorrectly	Provided, but the starting time is too soon	Provided, but the starting time is too late
Unstable Region (Tb > Tr)	Brake Applied	Decrease Braking Force to Wheel	Not hazardous	H2, H6, H3	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Unstable Region (Tb > Tr)	Brake Applied	Increase and Decrease Braking Force to Wheel	Not hazardous	H2, H6, H3	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Unstable Region (Tb > Tr)	Brake Not Applied	No Braking	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous
Unstable Region (Tb > Tr)	Brake Not Applied	Increase Braking Force to Wheel	Not hazardous	H2, H6, H3	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Unstable Region (Tb > Tr)	Brake Not Applied	Decrease Braking Force to Wheel	Not hazardous	H2, H6, H3	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Unstable Region (Tb > Tr)	Brake Not Applied	Increase and Decrease Braking Force to Wheel	Not hazardous	H2, H6, H3	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Unstable Region (Tb < Tr)	Brake Applied	No Braking	Not hazardous	H2, H6, H3	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Unstable Region (Tb < Tr)	Brake Applied	Increase Braking Force to Wheel	Not hazardous	H2, H6, H3	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided

Context Variables (Allow Hydraulic Pressure to Increase at Individual Wheel for ABS Function)			Guidewords for Assessing Whether the Control Action May Be Unsafe								
Mu-Slip Curve Region	Driver's Braking Command	Other Vehicle Systems' or Internal Brake System Functions Braking Request	Not provided in this context	Provided in this context	Provided, but duration is too long	Provided, but duration is too short	Provided, but the intensity is incorrect (too much)	Provided, but the intensity is incorrect (too little)	Provided, but executed incorrectly	Provided, but the starting time is too soon	Provided, but the starting time is too late
Unstable Region (Tb < Tr)	Brake Applied	Decrease Braking Force to Wheel	Not hazardous	H2, H6, H3	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Unstable Region (Tb < Tr)	Brake Applied	Increase and Decrease Braking Force to Wheel	Not hazardous	H2, H6, H3	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Unstable Region (Tb < Tr)	Brake Not Applied	No Braking	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous
Unstable Region (Tb < Tr)	Brake Not Applied	Increase Braking Force to Wheel	Not hazardous	H2, H6, H3	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Unstable Region (Tb < Tr)	Brake Not Applied	Decrease Braking Force to Wheel	Not hazardous	H2, H6, H3	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided

Context Variables (Allow Hydraulic Pressure to Increase at Individual Wheel for ABS Function)			**Guidewords for Assessing Whether the Control Action May Be Unsafe**								
Mu-Slip Curve Region	Driver's Braking Command	Other Vehicle Systems' or Internal Brake System Functions Braking Request	Not provided in this context	Provided in this context	Provided, but duration is too long	Provided, but duration is too short	Provided, but the intensity is incorrect (too much)	Provided, but the intensity is incorrect (too little)	Provided, but executed incorrectly	Provided, but the starting time is too soon	Provided, but the starting time is too late
Unstable Region (Tb < Tr)	Brake Not Applied	Increase and Decrease Braking Force to Wheel	Not hazardous	H2, H6, H3	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided

Vehicle Level Hazards:

- H1: Unintended Vehicle Lateral Motion/Unintended Yaw
- H1B: Unintended Vehicle Lateral Motion/Unintended Yaw – Improper Resolution of Conflicting Commands
- H2: Insufficient Vehicle Lateral Motion / Insufficient Yaw
- H2B: Insufficient Vehicle Lateral Motion / Insufficient Yaw – Improper Resolution of Conflicting Commands
- H3: Loss of Lateral Motion Control
- H4: Unintended Vehicle Deceleration
- H4B: Unintended Vehicle Deceleration – Improper Resolution of Conflicting Commands
- H6: Insufficient Vehicle Deceleration

Table D- 2: Control Action: “Allow Hydraulic Pressure to Decrease at Individual Wheel for ABS Function”

Context Variables (Allow Hydraulic Pressure to Decrease at Individual Wheel for ABS Function)			**Guidewords for Assessing Whether the Control Action May Be Unsafe**								
Mu-Slip Curve Region	Driver's Braking Command	Other Vehicle Systems' or Internal Brake System Functions Braking Request	Not provided in this context	Provided in this context	Provided, but duration is too long	Provided, but duration is too short	Provided, but the intensity is incorrect (too much)	Provided, but the intensity is incorrect (too little)	Provided, but executed incorrectly	Provided, but the starting time is too soon	Provided, but the starting time is too late
Stable Region	Brake Applied	No Braking	Not hazardous	H1, H2, H6	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Stable Region	Brake Applied	Increase Braking Force to Wheel	Not hazardous	H1, H2, H6	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Stable Region	Brake Applied	Decrease Braking Force to Wheel	H1B, H2B, H4B	H1, H2, H6	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Stable Region	Brake Applied	Increase and Decrease Braking Force to Wheel	H1B, H2B, H4B	H1, H2, H6	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Stable Region	Brake Not Applied	No Braking	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous
Stable Region	Brake Not Applied	Increase Braking Force to Wheel	Not hazardous	H1, H2, H6	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Stable Region	Brake Not Applied	Decrease Braking Force to Wheel	H1, H2, H4	Not hazardous	H1, H2, H6	H1, H2, H4	H1, H2, H6	H1, H2, H4	H1, H2, H4, H6	N/A	H1, H2, H4
Stable Region	Brake Not Applied	Increase and Decrease Braking Force to Wheel	H1B, H2B, H4B	H1, H2, H6	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Peak	Brake Applied	No Braking	Not hazardous	H1, H2, H6	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Peak	Brake Applied	Increase Braking Force to Wheel	Not hazardous	H1, H2, H6	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided

Context Variables (Allow Hydraulic Pressure to Decrease at Individual Wheel for ABS Function)			Guidewords for Assessing Whether the Control Action May Be Unsafe								
Mu-Slip Curve Region	Driver's Braking Command	Other Vehicle Systems' or Internal Brake System Functions Braking Request	Not provided in this context	Provided in this context	Provided, but duration is too long	Provided, but duration is too short	Provided, but the intensity is incorrect (too much)	Provided, but the intensity is incorrect (too little)	Provided, but executed incorrectly	Provided, but the starting time is too soon	Provided, but the starting time is too late
Peak	Brake Applied	Decrease Braking Force to Wheel	H1B, H2B, H4B	H1, H2, H6	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Peak	Brake Applied	Increase and Decrease Braking Force to Wheel	H1B, H2B, H4B	H1, H2, H6	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Peak	Brake Not Applied	No Braking	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous
Peak	Brake Not Applied	Increase Braking Force to Wheel	Not hazardous	H1, H2, H6	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Peak	Brake Not Applied	Decrease Braking Force to Wheel	H1, H2, H4	Not hazardous	H1, H2, H6	H1, H2, H4	H1, H2, H6	H1, H2, H4	H1, H2, H4, H6	N/A	H1, H2, H4
Peak	Brake Not Applied	Increase and Decrease Braking Force to Wheel	H1B, H2B, H4B	H1, H2, H6	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Unstable Region (Tb > Tr)	Brake Applied	No Braking	H2, H6, H3	Not hazardous	H1, H2, H6	H2, H6, H3	H1, H2, H6	H2, H6, H3	H1, H2, H4, H6, H3	N/A	H2, H6, H3
Unstable Region (Tb > Tr)	Brake Applied	Increase Braking Force to Wheel	H2, H6, H3	Not hazardous	H1, H2, H6	H2, H6, H3	H1, H2, H6	H2, H6, H3	H1, H2, H4, H6, H3	N/A	H2, H6, H3
Unstable Region (Tb > Tr)	Brake Applied	Decrease Braking Force to Wheel	H2, H6, H3	Not hazardous	H1, H2, H6	H2, H6, H3	H1, H2, H6	H2, H6, H3	H1, H2, H4, H6, H3	N/A	H2, H6, H3

Context Variables (Allow Hydraulic Pressure to Decrease at Individual Wheel for ABS Function)			Guidewords for Assessing Whether the Control Action May Be Unsafe								
Mu-Slip Curve Region	Driver's Braking Command	Other Vehicle Systems' or Internal Brake System Functions Braking Request	Not provided in this context	Provided in this context	Provided, but duration is too long	Provided, but duration is too short	Provided, but the intensity is incorrect (too much)	Provided, but the intensity is incorrect (too little)	Provided, but executed incorrectly	Provided, but the starting time is too soon	Provided, but the starting time is too late
Unstable Region (Tb > Tr)	Brake Applied	Increase and Decrease Braking Force to Wheel	H2, H6, H3	Not hazardous	H1, H2, H6	H2, H6, H3	H1, H2, H6	H2, H6, H3	H1, H2, H4, H6, H3	N/A	H2, H6, H3
Unstable Region (Tb > Tr)	Brake Not Applied	No Braking	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous
Unstable Region (Tb > Tr)	Brake Not Applied	Increase Braking Force to Wheel	H2, H6, H3	Not hazardous	H1, H2, H6	H2, H6, H3	H1, H2, H6	H2, H6, H3	H1, H2, H4, H6, H3	N/A	H2, H6, H3
Unstable Region (Tb > Tr)	Brake Not Applied	Decrease Braking Force to Wheel	H2, H6, H3	Not hazardous	H1, H2, H6	H2, H6, H3	H1, H2, H6	H2, H6, H3	H1, H2, H4, H6, H3	N/A	H2, H6, H3
Unstable Region (Tb > Tr)	Brake Not Applied	Increase and Decrease Braking Force to Wheel	H2, H6, H3	Not hazardous	H1, H2, H6	H2, H6, H3	H1, H2, H6	H2, H6, H3	H1, H2, H4, H6, H3	N/A	H2, H6, H3
Unstable Region (Tb < Tr)	Brake Applied	No Braking	Not hazardous	H1, H2, H6	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Unstable Region (Tb < Tr)	Brake Applied	Increase Braking Force to Wheel	Not hazardous	H1, H2, H6	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Unstable Region (Tb < Tr)	Brake Applied	Decrease Braking Force to Wheel	H1B, H2B, H4B	H1, H2, H6	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided

Context Variables (Allow Hydraulic Pressure to Decrease at Individual Wheel for ABS Function)			Guidewords for Assessing Whether the Control Action May Be Unsafe								
Mu-Slip Curve Region	Driver's Braking Command	Other Vehicle Systems' or Internal Brake System Functions Braking Request	Not provided in this context	Provided in this context	Provided, but duration is too long	Provided, but duration is too short	Provided, but the intensity is incorrect (too much)	Provided, but the intensity is incorrect (too little)	Provided, but executed incorrectly	Provided, but the starting time is too soon	Provided, but the starting time is too late
Unstable Region (Tb < Tr)	Brake Applied	Increase and Decrease Braking Force to Wheel	H1B, H2B, H4B	H1, H2, H6	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Unstable Region (Tb < Tr)	Brake Not Applied	No Braking	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous
Unstable Region (Tb < Tr)	Brake Not Applied	Increase Braking Force to Wheel	Not hazardous	H1, H2, H6	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Unstable Region (Tb < Tr)	Brake Not Applied	Decrease Braking Force to Wheel	H1, H2, H4	Not hazardous	H1, H2, H6	H1, H2, H4	H1, H2, H6	H1, H2, H4	H1, H2, H4, H6	N/A	H1, H2, H4
Unstable Region (Tb < Tr)	Brake Not Applied	Increase and Decrease Braking Force to Wheel	H1B, H2B, H4B	H1, H2, H6	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided

Vehicle Level Hazards:

- H1: Unintended Vehicle Lateral Motion/Unintended Yaw
- H1B: Unintended Vehicle Lateral Motion/Unintended Yaw – Improper Resolution of Conflicting Commands
- H2: Insufficient Vehicle Lateral Motion / Insufficient Yaw
- H2B: Insufficient Vehicle Lateral Motion / Insufficient Yaw – Improper Resolution of Conflicting Commands
- H3: Loss of Lateral Motion Control
- H4: Unintended Vehicle Deceleration
- H4B: Unintended Vehicle Deceleration – Improper Resolution of Conflicting Commands
- H6: Insufficient Vehicle Deceleration

Table D- 3: Control Action: "Adjust Hydraulic Pressure at Wheels to Induce Yaw in θ Direction (ESC)"

Context Variables (Adjust Hydraulic Pressure at Wheels to Induce Yaw in θ Direction (ESC))			**Guidewords for Assessing Whether the Control Action May Be Unsafe**								
Driver's Braking Command	Yaw Error btw. Driver Command and Vehicle Dynamics	Other Internal Brake System or Vehicle Systems' Yaw/Differential Braking Requests	Not provided in this context	Provided in this context	Provided, but duration is too long	Provided, but duration is too short	Provided, but the intensity is incorrect (too much)	Provided, but the intensity is incorrect (too little)	Provided, but executed incorrectly	Provided, but the starting time is too soon	Provided, but the starting time is too late
Brake Applied	No Error	No Yaw/Differential Braking	Not hazardous	H1	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Applied	No Error	Yaw/Differential Braking in θ Direction	H2, H2B	Not hazardous	H1	H2	H1	H2	H1, H2, H4	N/A	H2
Brake Applied	No Error	Yaw/Differential Braking in -θ Direction	Not hazardous	H1	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Applied	No Error	Yaw/Differential Braking in both θ and -θ Direction	H2B	H1B	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Applied	Error in θ Direction	No Yaw/Differential Braking	H1, H2	Not hazardous	H1	H2	H1	H2	H1, H2, H4	N/A	H2

Context Variables (Adjust Hydraulic Pressure at Wheels to Induce Yaw in θ Direction (ESC))			Guidewords for Assessing Whether the Control Action May Be Unsafe								
Driver's Braking Command	Yaw Error btw. Driver Command and Vehicle Dynamics	Other Internal Brake System or Vehicle Systems' Yaw/Differential Braking Requests	Not provided in this context	Provided in this context	Provided, but duration is too long	Provided, but duration is too short	Provided, but the intensity is incorrect (too much)	Provided, but the intensity is incorrect (too little)	Provided, but executed incorrectly	Provided, but the starting time is too soon	Provided, but the starting time is too late
Brake Applied	Error in θ Direction	Yaw/Differential Braking in θ Direction	H1, H2	Not hazardous	H1	H2	H1	H2	H1, H2, H4	N/A	H2
Brake Applied	Error in θ Direction	Yaw/Differential Braking in -θ Direction	H1, H2, H1B, H2B	H1B	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Applied	Error in θ Direction	Yaw/Differential Braking in both θ and -θ Direction	H1, H2, H1B, H2B	H1B	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Applied	Error in -θ Direction	No Yaw/Differential Braking	Not hazardous	H1	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Applied	Error in -θ Direction	Yaw/Differential Braking in θ Direction	H2B	H1B	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Applied	Error in -θ Direction	Yaw/Differential Braking in -θ Direction	Not hazardous	H1	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided

Context Variables (Adjust Hydraulic Pressure at Wheels to Induce Yaw in θ Direction (ESC))			Guidewords for Assessing Whether the Control Action May Be Unsafe									
Driver's Braking Command	Yaw Error btw. Driver Command and Vehicle Dynamics	Other Internal Brake System or Vehicle Systems' Yaw/Differential Braking Requests	Not provided in this context	Provided in this context	Provided, but duration is too long	Provided, but duration is too short	Provided, but the intensity is incorrect (too much)	Provided, but the intensity is incorrect (too little)	Provided, but executed incorrectly	Provided, but the starting time is too soon	Provided, but the starting time is too late
Brake Applied	Error in -θ Direction	Yaw/Differential Braking in both θ and -θ Direction	H2B	H1B	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Not Applied	No Error	No Yaw/Differential Braking	Not hazardous	H1	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Not Applied	No Error	Yaw/Differential Braking in θ Direction	H2	Not hazardous	H1	H2	H1	H2	H1, H2, H4	N/A	H2
Brake Not Applied	No Error	Yaw/Differential Braking in -θ Direction	Not hazardous	H1	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Not Applied	No Error	Yaw/Differential Braking in both θ and -θ Direction	H2B	H1B	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Not Applied	Error in θ Direction	No Yaw/Differential Braking	H1, H2	Not hazardous	H1	H2	H1	H2	H1, H2, H4	N/A	H2

Context Variables (Adjust Hydraulic Pressure at Wheels to Induce Yaw in θ Direction (ESC))			Guidewords for Assessing Whether the Control Action May Be Unsafe								
Driver's Braking Command	Yaw Error btw. Driver Command and Vehicle Dynamics	Other Internal Brake System or Vehicle Systems' Yaw/Differential Braking Requests	Not provided in this context	Provided in this context	Provided, but duration is too long	Provided, but duration is too short	Provided, but the intensity is incorrect (too much)	Provided, but the intensity is incorrect (too little)	Provided, but executed incorrectly	Provided, but the starting time is too soon	Provided, but the starting time is too late
Brake Not Applied	Error in θ Direction	Yaw/Differential Braking in θ Direction	H1, H2	Not hazardous	H1	H2	H1	H2	H1, H2, H4	N/A	H2
Brake Not Applied	Error in θ Direction	Yaw/Differential Braking in -θ Direction	H1, H2, H1B, H2B	H1B	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Not Applied	Error in θ Direction	Yaw/Differential Braking in both θ and -θ Direction	H1, H2, H1B, H2B	H1B	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Not Applied	Error in -θ Direction	No Yaw/Differential Braking	Not hazardous	H1	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Not Applied	Error in -θ Direction	Yaw/Differential Braking in θ Direction	H2B	H1B	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Not Applied	Error in -θ Direction	Yaw/Differential Braking in -θ Direction	Not hazardous	H1	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided

Context Variables (Adjust Hydraulic Pressure at Wheels to Induce Yaw in θ Direction (ESC))			**Guidewords for Assessing Whether the Control Action May Be Unsafe**									
Driver's Braking Command	Yaw Error btw. Driver Command and Vehicle Dynamics	Other Internal Brake System or Vehicle Systems' Yaw/Differential Braking Requests	Not provided in this context	Provided in this context	Provided, but duration is too long	Provided, but duration is too short	Provided, but the intensity is incorrect (too much)	Provided, but the intensity is incorrect (too little)	Provided, but executed incorrectly	Provided, but the starting time is too soon	Provided, but the starting time is too late
Brake Not Applied	Error in -θ Direction	Yaw/Differential Braking in both θ and -θ Direction	H2B	H1B	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided

Vehicle Level Hazards:

- H1: Unintended Vehicle Lateral Motion/Unintended Yaw
- H1B: Unintended Vehicle Lateral Motion/Unintended Yaw – Improper Resolution of Conflicting Commands
- H2: Insufficient Vehicle Lateral Motion / Insufficient Yaw
- H2B: Insufficient Vehicle Lateral Motion / Insufficient Yaw – Improper Resolution of Conflicting Commands
- H4: Unintended Vehicle Deceleration

Table D- 4: Control Action: “Increase Hydraulic Pressure at Individual Wheel for TCS Function”

Context Variables (Increase Hydraulic Pressure at Individual Wheel for TCS Function)		**Guidewords for Assessing Whether the Control Action May Be Unsafe**								
Mu-Slip Curve Region	Acceleration Request (Driver and/or Other Vehicle Systems)	Not provided in this context	Provided in this context	Provided, but duration is too long	Provided, but duration is too short	Provided, but the intensity is incorrect (too much)	Provided, but the intensity is incorrect (too little)	Provided, but executed incorrectly	Provided, but the starting time is too soon	Provided, but the starting time is too late
Stable Region	Yes	Not hazardous	H1, H4, H8	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Stable Region	No	Not hazardous	H1, H4	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Peak	Yes	Not hazardous	H1, H4, H8	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Peak	No	Not hazardous	H1, H4	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Unstable Region (Te > Tr)	Yes	H1, H8	Not hazardous	H1, H4, H8	H1, H8	H1, H4, H8	H1, H8	H1, H4, H8	N/A	H1, H8
Unstable Region (Te > Tr)	No	Not hazardous	H1, H4	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Unstable Region (Te < Tr)	Yes	Not hazardous	H1, H4, H8	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Unstable Region (Te < Tr)	No	Not hazardous	H1, H4	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Vehicle Level Hazards: • H1: Unintended Vehicle Lateral Motion/Unintended Yaw • H4: Unintended Vehicle Deceleration • H8: Insufficient Vehicle Propulsion										

Table D- 5: Control Action: “Decrease Hydraulic Pressure at Individual Wheel for TCS Function”

Context Variables (Decrease Hydraulic Pressure at Individual Wheel for TCS Function)		**Guidewords for Assessing Whether the Control Action May Be Unsafe**								
Mu-Slip Curve Region	Acceleration Request (Driver and/or Other Vehicle Systems)	Not provided in this context	Provided in this context	Provided, but duration is too long	Provided, but duration is too short	Provided, but the intensity is incorrect (too much)	Provided, but the intensity is incorrect (too little)	Provided, but executed incorrectly	Provided, but the starting time is too soon	Provided, but the starting time is too late
Stable Region	Yes	H1, H4, H8	Not hazardous	Not hazardous	H1, H4, H8	Not hazardous	H1, H4, H8	H1, H4, H8	N/A	H1, H4, H8
Stable Region	No	H1, H4	Not hazardous	Not hazardous	H1, H4	Not hazardous	H1, H4	H1, H4	N/A	H1, H4
Peak	Yes	H1, H4, H8	Not hazardous	Not hazardous	H1, H4, H8	Not hazardous	H1, H4, H8	H1, H4, H8	N/A	H1, H4, H8
Peak	No	H1, H4	Not hazardous	Not hazardous	H1, H4	Not hazardous	H1, H4	H1, H4	N/A	H1, H4
Unstable Region (Te > Tr)	Yes	Not hazardous	H1, H8	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Unstable Region (Te > Tr)	No	Not hazardous	H1	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Unstable Region (Te < Tr)	Yes	H1, H4, H8	Not hazardous	Not hazardous	H1, H4, H8	Not hazardous	H1, H4, H8	H1, H4, H8	N/A	H1, H4, H8
Unstable Region (Te < Tr)	No	H1, H4	Not hazardous	Not hazardous	H1, H4	Not hazardous	H1, H4	H1, H4	N/A	H1, H4

Vehicle Level Hazards:

- H1: Unintended Vehicle Lateral Motion/Unintended Yaw
- H4: Unintended Vehicle Deceleration
- H8: Insufficient Vehicle Propulsion

Table D- 6: Control Action: "Increase Hydraulic Pressure to Brake All Wheels"

Context Variables (Increase Hydraulic Pressure to Brake All Wheels)		Guidewords for Assessing Whether the Control Action May Be Unsafe								
Driver's Braking Command	Other Internal Brake System or Vehicle Systems' Yaw/Differential Braking Requests	Not provided in this context	Provided in this context	Provided, but duration is too long	Provided, but duration is too short	Provided, but the intensity is incorrect (too much)	Provided, but the intensity is incorrect (too little)	Provided, but executed incorrectly	Provided, but the starting time is too soon	Provided, but the starting time is too late
Brake Applied	No Braking	Not hazardous	H4	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Applied	Increase Braking on All Wheels	H6	Not hazardous	H4	H6	H4	H6	H1, H4, H6	N/A	H6
Brake Applied	Decrease Braking on All Wheels	Not hazardous	H4	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Applied	Both Increase and Decrease Braking on All Wheels	H6B	H4B	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Applied	Yaw/Differential Braking	Not hazardous	H2, H4	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Applied	Increase Braking on All Wheels and Yaw/Differential Braking	H6B	H2B, H4B	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Applied	Decrease Braking on All Wheels and Yaw/Differential Braking	Not hazardous	H2, H4	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Applied	Both Increase and Decrease Braking on All Wheels, and Yaw/Differential Braking	H6B	H2B, H4B	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Not Applied	No Braking	Not hazardous	H4	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided

Context Variables (Increase Hydraulic Pressure to Brake All Wheels)		Guidewords for Assessing Whether the Control Action May Be Unsafe								
Driver's Braking Command	Other Internal Brake System or Vehicle Systems' Yaw/Differential Braking Requests	Not provided in this context	Provided in this context	Provided, but duration is too long	Provided, but duration is too short	Provided, but the intensity is incorrect (too much)	Provided, but the intensity is incorrect (too little)	Provided, but executed incorrectly	Provided, but the starting time is too soon	Provided, but the starting time is too late
Brake Not Applied	Increase Braking on All Wheels	H6	Not hazardous	H4	H6	H4	H6	H1, H4, H6	N/A	H6
Brake Not Applied	Decrease Braking on All Wheels	Not hazardous	H4	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Not Applied	Both Increase and Decrease Braking on All Wheels	H6B	H4B	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Not Applied	Yaw/Differential Braking	Not hazardous	H2, H4	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Not Applied	Increase Braking on All Wheels and Yaw/Differential Braking	H6B	H2B, H4B	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Not Applied	Decrease Braking on All Wheels and Yaw/Differential Braking	Not hazardous	H2, H4	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided

Context Variables (Increase Hydraulic Pressure to Brake All Wheels)		Guidewords for Assessing Whether the Control Action May Be Unsafe								
Driver's Braking Command	Other Internal Brake System or Vehicle Systems' Yaw/Differential Braking Requests	Not provided in this context	Provided in this context	Provided, but duration is too long	Provided, but duration is too short	Provided, but the intensity is incorrect (too much)	Provided, but the intensity is incorrect (too little)	Provided, but executed incorrectly	Provided, but the starting time is too soon	Provided, but the starting time is too late
Brake Not Applied	Both Increase and Decrease Braking on All Wheels, and Yaw/Differential Braking	H6B	H2B, H4B	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided

Vehicle Level Hazards:

- H1: Unintended Vehicle Lateral Motion/Unintended Yaw
- H2: Insufficient Vehicle Lateral Motion/Insufficient Yaw
- H2B: Insufficient Vehicle Lateral Motion/Insufficient Yaw – Improper Resolution of Conflicting Commands
- H4: Unintended Vehicle Deceleration
- H4B: Unintended Vehicle Deceleration – Improper Resolution of Conflicting Commands
- H6: Insufficient Vehicle Deceleration
- H6B: Insufficient Vehicle Deceleration – Improper Resolution of Conflicting Commands

Table D- 7: Control Action: "Decrease Hydraulic Pressure to Brake All Wheels"

Context Variables (Decrease Hydraulic Pressure to Brake All Wheels)		**Guidewords for Assessing Whether the Control Action May Be Unsafe**								
Driver's Braking Command	Other Internal Brake System or Vehicle Systems' Yaw/Differential Braking Requests	Not provided in this context	Provided in this context	Provided, but duration is too long	Provided, but duration is too short	Provided, but the intensity is incorrect (too much)	Provided, but the intensity is incorrect (too little)	Provided, but executed incorrectly	Provided, but the starting time is too soon	Provided, but the starting time is too late
Brake Applied	No Braking	Not hazardous	H6	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Applied	Increase Braking on All Wheels	Not hazardous	H6	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Applied	Decrease Braking on All Wheels	H4B	H6B	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Applied	Both Increase and Decrease Braking on All Wheels	H4B	H6B	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Applied	Yaw/Differential Braking	Not hazardous	H2, H6	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Applied	Increase Braking on All Wheels and Yaw/Differential Braking	Not hazardous	H2, H6	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Applied	Decrease Braking on All Wheels and Yaw/Differential Braking	H4B	H2B, H6B	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided

Context Variables (Decrease Hydraulic Pressure to Brake All Wheels)		Guidewords for Assessing Whether the Control Action May Be Unsafe								
Driver's Braking Command	Other Internal Brake System or Vehicle Systems' Yaw/Differential Braking Requests	Not provided in this context	Provided in this context	Provided, but duration is too long	Provided, but duration is too short	Provided, but the intensity is incorrect (too much)	Provided, but the intensity is incorrect (too little)	Provided, but executed incorrectly	Provided, but the starting time is too soon	Provided, but the starting time is too late
Brake Applied	Both Increase and Decrease Braking on All Wheels, and Yaw/Differential Braking	H4B	H2B, H6B	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Not Applied	No Braking	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous	Not hazardous
Brake Not Applied	Increase Braking on All Wheels	Not hazardous	H6	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Not Applied	Decrease Braking on All Wheels	H4	Not hazardous	H6	H4	H6	H4	H1, H4, H6	N/A	H4
Brake Not Applied	Both Increase and Decrease Braking on All Wheels	H4B	H6B	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Not Applied	Yaw/Differential Braking	Not hazardous	H2	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Not Applied	Increase Braking on All Wheels and Yaw/Differential Braking	Not hazardous	H2, H6	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Brake Not Applied	Decrease Braking on All Wheels and Yaw/Differential Braking	H4B	H2B	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided

Context Variables (Decrease Hydraulic Pressure to Brake All Wheels)		Guidewords for Assessing Whether the Control Action May Be Unsafe								
Driver's Braking Command	Other Internal Brake System or Vehicle Systems' Yaw/Differential Braking Requests	Not provided in this context	Provided in this context	Provided, but duration is too long	Provided, but duration is too short	Provided, but the intensity is incorrect (too much)	Provided, but the intensity is incorrect (too little)	Provided, but executed incorrectly	Provided, but the starting time is too soon	Provided, but the starting time is too late
Brake Not Applied	Both Increase and Decrease Braking on All Wheels, and Yaw/Differential Braking	H4B	H2B, H6B	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided

Vehicle Level Hazards:

- H1: Unintended Vehicle Lateral Motion/Unintended Yaw
- H2: Insufficient Vehicle Lateral Motion/Insufficient Yaw
- H2B: Insufficient Vehicle Lateral Motion/Insufficient Yaw – Improper Resolution of Conflicting Commands
- H4: Unintended Vehicle Deceleration
- H4B: Unintended Vehicle Deceleration – Improper Resolution of Conflicting Commands
- H6: Insufficient Vehicle Deceleration
- H6B: Insufficient Vehicle Deceleration – Improper Resolution of Conflicting Commands

Table D- 8: Control Action: "Request Increase in Propulsion Torque"

Context Variables (Request Increase in Propulsion Torque)	**Guidewords for Assessing Whether the Control Action May Be Unsafe**								
Propulsion Torque Increase Required for Brake Function	Not provided in this context	Provided in this context	Provided, but duration is too long	Provided, but duration is too short	Provided, but the intensity is incorrect (too much)	Provided, but the intensity is incorrect (too little)	Provided, but executed incorrectly	Provided, but the starting time is too soon	Provided, but the starting time is too late
No	Not hazardous	H6, H7	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Yes	H1, H2, H8, H10	Not hazardous	H6, H7	H1, H2, H8, H10	H6, H7	H1, H2, H8, H10	H1, H2, H6, H7, H8, H10	N/A	H1, H2, H8, H10

Vehicle Level Hazards:

- H1: Unintended Vehicle Lateral Motion/Unintended Yaw
- H2: Insufficient Vehicle Lateral Motion/Insufficient Yaw
- H6: Insufficient Vehicle Deceleration
- H7: Unintended Vehicle Propulsion
- H8: Insufficient Vehicle Propulsion
- H10: Propulsion Power Reduction/Loss or Vehicle Stalling

Table D- 9: Control Action: “Request Decrease in Propulsion Torque”

Context Variables (Request Decrease in Propulsion Torque)	**Guidewords for Assessing Whether the Control Action May Be Unsafe**								
Propulsion Torque Decrease Required for Brake Function	Not provided in this context	Provided in this context	Provided, but duration is too long	Provided, but duration is too short	Provided, but the intensity is incorrect (too much)	Provided, but the intensity is incorrect (too little)	Provided, but executed incorrectly	Provided, but the starting time is too soon	Provided, but the starting time is too late
No	Not hazardous	H10, H8	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Yes	H1, H2, H6	Not hazardous	H10, H8	H1, H2, H6	H10, H8	H1, H2, H6	H1, H2, H6, H10, H8	N/A	H1, H2, H6
Vehicle Level Hazards: • H1: Unintended Vehicle Lateral Motion/Unintended Yaw • H2: Insufficient Vehicle Lateral Motion/Insufficient Yaw • H6: Insufficient Vehicle Deceleration • H8: Insufficient Vehicle Propulsion • H10: Propulsion Power Reduction/Loss or Vehicle Stalling									

Table D- 10: Control Action: "Request Steering Adjustment"

Context Variables (Request Steering Adjustment)	Guidewords for Assessing Whether the Control Action May Be Unsafe							
Steering Adjustment Required for Brake Function	Not provided in this context	Provided in this context	Provided, but duration is too long	Provided, but duration is too short	Provided, but the intensity is incorrect (too much)	Provided, but the intensity is incorrect (too little)	Provided, but executed incorrectly	Provided, but the starting time is too soon	Provided, but the starting time is too late
Yes	H1, H2	Not hazardous	H1	H1, H2	H1	H1, H2	H1, H2	N/A	H1, H2
No	Not hazardous	H1	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Vehicle Level Hazards: • H1: Unintended Vehicle Lateral Motion/Unintended Yaw • H2: Insufficient Vehicle Lateral Motion/Insufficient Yaw									

Table D- 11: Control Action: "Calculate Vehicle Speed"

Context Variables (Calculate Vehicle Speed)	Guidewords for Assessing Whether the Control Action May Be Unsafe							
None	Not provided in this context	Provided in this context	Provided, but duration is too long	Provided, but duration is too short	Provided, but the intensity is incorrect (too much)	Provided, but the intensity is incorrect (too little)	Provided, but executed incorrectly	Provided, but the starting time is too soon	Provided, but the starting time is too late
N/A	H1, H2, H4, H6, H7, H10	Not hazardous	N/A	N/A	H1, H2, H4, H10	H1, H2, H6, H7	H1, H2, H4, H6, H7, H10	N/A	H1, H2, H4, H6, H7, H10

Vehicle Level Hazards:

- H1: Unintended Vehicle Lateral Motion/Unintended Yaw
- H2: Insufficient Vehicle Lateral Motion/Insufficient Yaw
- H4: Unintended Vehicle Deceleration
- H6: Insufficient Vehicle Deceleration
- H7: Uncontrolled Vehicle Propulsion
- H10: Propulsion Power Reduction/Loss or Vehicle Stalling

Table D- 12: Control Action: "Increase Angular Position of Brake Pedal"

Context Variables (Increase Angular Position of Brake Pedal)	**Guidewords for Assessing Whether the Control Action May Be Unsafe**								
Is Braking Needed	Not provided in this context	Provided in this context	Provided, but duration is too long	Provided, but duration is too short	Provided, but the intensity is incorrect (too much)	Provided, but the intensity is incorrect (too little)	Provided, but executed incorrectly	Provided, but the starting time is too soon	Provided, but the starting time is too late
Yes	H6	Not hazardous	Not hazardous	H6	H4	H6	H4, H7	Does not apply	H6
No	Not hazardous	H4	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Vehicle Level Hazards: • H4: Unintended Vehicle Deceleration • H6: Insufficient Vehicle Deceleration									

Table D- 13: Control Action: "Decrease Angular Position of Brake Pedal"

Context Variables (Decrease Angular Position of Brake Pedal)	**Guidewords for Assessing Whether the Control Action May Be Unsafe**								
Is Braking Needed	Not provided in this context	Provided in this context	Provided, but duration is too long	Provided, but duration is too short	Provided, but the intensity is incorrect (too much)	Provided, but the intensity is incorrect (too little)	Provided, but executed incorrectly	Provided, but the starting time is too soon	Provided, but the starting time is too late
Yes	Not hazardous	H6	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
No	Not hazardous	Not hazardous	Not hazardous	Not hazardous	H6	Not hazardous	H4, H6	H6	Not hazardous
Vehicle Level Hazards: • H4: Unintended Vehicle Deceleration • H6: Insufficient Vehicle Deceleration									

Table D- 14: Control Action: "Disable Stability Control"

Context Variables (Disable Stability Control)	**Guidewords for Assessing Whether the Control Action May Be Unsafe**								
Stability Control System Status	Not provided in this context	Provided in this context	Provided, but duration is too long	Provided, but duration is too short	Provided, but the intensity is incorrect (too much)	Provided, but the intensity is incorrect (too little)	Provided, but executed incorrectly	Provided, but the starting time is too soon	Provided, but the starting time is too late
Enabled	Not hazardous	Not hazardous	H1, H10	H1, H10	H1, H10	H1, H10	H1, H10	N/A	N/A
Disabled	Not hazardous	H1, H10	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Vehicle Level Hazards: • H1: Unintended Vehicle Lateral Motion / Unintended Yaw • H10: Propulsion Power Reduction/Loss or Vehicle Stalling									

Table D- 15: Control Action: "Enable Stability Control"

Context Variables (Enable Stability Control)	Guidewords for Assessing Whether the Control Action May Be Unsafe								
Stability Control System Status	Not provided in this context	Provided in this context	Provided, but duration is too long	Provided, but duration is too short	Provided, but the intensity is incorrect (too much)	Provided, but the intensity is incorrect (too little)	Provided, but executed incorrectly	Provided, but the starting time is too soon	Provided, but the starting time is too late
Enabled	Not hazardous	H1, H2	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided	Hazardous if provided
Disabled	Not hazardous	Not hazardous	H1, H2	H1, H2	H1, H2	H1, H2	H1, H2	N/A	N/A

Vehicle Level Hazards:

- H1: Unintended Vehicle Lateral Motion / Unintended Yaw
- H2: Insufficient Vehicle Lateral Motion / Insufficient Yaw

APPENDIX E: STPA STEP 1: UCAS AND MAPPING TO HAZARDS

Table E-1: Unsafe Control Actions for the "Allow Hydraulic Pressure to Increase at Individual Wheel for ABS Function" Control Action

Vehicle Level Hazard	**Unsafe Control Actions** **(Allow Hydraulic Pressure to Increase at Individual Wheel for ABS Function)**
H1B, H2B, H4B	The brake/stability control module allows the hydraulic pressure to increase at an individual wheel for the ABS function when: - the mu-slip curve is in the stable region, - the driver is applying the brakes, and - other vehicle systems or internal brake functions are requesting a decrease in brake force at the wheel.
H1B, H2B, H4B	The brake/stability control module allows the hydraulic pressure to increase at an individual wheel for the ABS function when: - the mu-slip curve is in the stable region, and - other vehicle systems or internal brake functions are requesting both an increase and decrease in brake force at the wheel.
H1, H2, H4	The brake/stability control module allows the hydraulic pressure to increase at an individual wheel for the ABS function when: - the mu-slip curve is in the stable region, - the driver is not applying the brakes, and - other vehicle systems or internal brake functions are requesting a decrease in brake force at the wheel.
H2, H3, H6	The brake/stability control module allows the hydraulic pressure to increase at an individual wheel for the ABS function when: - the mu-slip curve is at the peak or in an unstable region, and - the driver is applying the brakes.
H2, H3, H6	The brake/stability control module allows the hydraulic pressure to increase at an individual wheel for the ABS function when: - the mu-slip curve is at the peak or in an unstable region, and - other vehicle systems or internal brake functions are requesting an increase, decrease, or both an increase and decrease in braking force to the wheel.
H6	The brake/stability control module does not allow the hydraulic pressure to increase at an individual wheel for the ABS function when: - the mu-slip curve is in the stable region, and - the driver is applying the brakes.

Vehicle Level Hazard	**Unsafe Control Actions** **(Allow Hydraulic Pressure to Increase at Individual Wheel for ABS Function)**
H6	The brake/stability control module does not allow the hydraulic pressure to increase at an individual wheel for the ABS function when: - the mu-slip curve is in the stable region, and - other vehicle systems or internal brake functions are requesting either an increase in brake force at the wheel or both an increase and reduction in brake force at the wheel.
H2, H3, H6	The brake/stability control module allows the hydraulic pressure to increase at an individual wheel for the ABS function when: - the mu-slip curve is in the stable region, - the driver is applying the brakes, and - other vehicle systems or internal brake functions are not requesting a change in the braking force to the wheel, but the command is issued for too long (e.g., persists after the wheel leaves the stable region).
H2, H3, H6	The brake/stability control module allows the hydraulic pressure to increase at an individual wheel for the ABS function when: - the mu-slip curve is in the stable region, and - other vehicle systems or internal brake functions are requesting an increase in the braking force to the wheel, but the command is issued for too long (e.g., persists after the wheel leaves the stable region).
H1, H2, H6	The brake/stability control module allows the hydraulic pressure to increase at an individual wheel for the ABS function when: - the mu-slip curve is in the stable region, - the driver is applying the brakes, and - other vehicle systems or internal brake functions are not requesting a change in the braking force to the wheel, but the command is issued for too short a period.
H1, H2, H6	The brake/stability control module allows the hydraulic pressure to increase at an individual wheel for the ABS function when: - the mu-slip curve is in the stable region, and - other vehicle systems or internal brake functions are requesting an increase in the braking force to the wheel, but the command is issued for too short a period.
H1, H2, H3, H6	The brake/stability control module correctly issues the command to allow the hydraulic pressure to increase at an individual wheel for the ABS function, but the command is executed incorrectly.

Vehicle Level Hazard	Unsafe Control Actions (Allow Hydraulic Pressure to Increase at Individual Wheel for ABS Function)
H1, H2, H6	The brake/stability control module allows the hydraulic pressure to increase at an individual wheel for the ABS function when: - the mu-slip curve is in the stable region, - the driver is applying the brakes, and - other vehicle systems or internal brake functions are not requesting a change in the braking force to the wheel, but the command is issued too late.
H1, H2, H6	The brake/stability control module allows the hydraulic pressure to increase at an individual wheel for the ABS function when: - the mu-slip curve is in the stable region, and - other vehicle systems or internal brake functions are requesting an increase in the braking force to the wheel, but the command is issued too late.

H1: Unintended Vehicle Lateral Motion / Unintended Yaw
H1B: Unintended Vehicle Lateral Motion / Unintended Yaw – Improper Resolution of Conflicting Commands
H2: Insufficient Vehicle Lateral Motion / Insufficient Yaw
H2B: Insufficient Vehicle Lateral Motion / Insufficient Yaw – Improper Resolution of Conflicting Commands
H3: Loss of Lateral Motion Control
H4: Unintended Vehicle Deceleration
H4B: Unintended Vehicle Deceleration – Improper Resolution of Conflicting Commands
H6: Insufficient Vehicle Deceleration

Table E-2: Unsafe Control Actions for the "Allow Hydraulic Pressure to Decrease at Individual Wheel for ABS Function" Control Action

Vehicle Level Hazard	Unsafe Control Actions (Allow Hydraulic Pressure to Decrease at Individual Wheel for ABS Function)
H1B, H2B, H4B	The brake/stability control module does not allow the brake pressure to decrease at an individual wheel for the ABS function when: - the mu-slip curve is in the stable region, at its peak, or the unstable region where Tb < Tr, - the brake is applied, and - other vehicle systems or internal brake functions are requesting a decrease in the brake force at the wheel.
H1B, H2B, H4B	The brake/stability control module does not allow the brake pressure to decrease at an individual wheel for the ABS function when: - the mu-slip curve is in the stable region, at its peak, or the unstable region where Tb < Tr, and - other vehicle systems or internal brake functions are requesting both an increase and decrease in the brake force at the wheel.
H1, H2, H4	The brake/stability control module does not allow the brake pressure to decrease at an individual wheel for the ABS function when: - the mu-slip curve is in the stable region, at its peak, or the unstable region where Tb < Tr, - the brake is not applied, and - other vehicle systems or internal brake functions are requesting a decrease in the brake force at the wheel.
H2, H3, H6	The brake/stability control module does not allow the brake pressure to decrease at an individual wheel for the ABS function when: - the mu-slip curve is in the unstable region where Tb > Tr, and - the brake is applied.
H2, H3, H6	The brake/stability control module does not allow the brake pressure to decrease at an individual wheel for the ABS function when: - the mu-slip curve is in the unstable region where Tb > Tr, and - other vehicle systems or internal brake functions are requesting an increase, a decrease, or both an increase and decrease in brake force at the wheel.
H1, H2, H6	The brake/stability control module allows the brake pressure to decrease at an individual wheel for the ABS function when: - the mu-slip curve is in the stable region, at its peak, or the unstable region where Tb < Tr, and - the brake is applied.

Vehicle Level Hazard	Unsafe Control Actions (Allow Hydraulic Pressure to Decrease at Individual Wheel for ABS Function)
H1, H2, H6	The brake/stability control module allows the brake pressure to decrease at an individual wheel for the ABS function when: - the mu-slip curve is in the stable region, at its peak, or the unstable region where Tb < Tr, and - other vehicle systems or internal brake functions are requesting an increase, or both an increase and decrease in brake force at the wheel.
H1, H2, H6	The brake/stability control module allows the brake pressure to decrease at an individual wheel for the ABS function when: - the mu-slip curve is in the unstable region where Tb > Tr, and - the brake is applied, but the command is issued for too long.
H1, H2, H6	The brake/stability control module allows the brake pressure to decrease at an individual wheel for the ABS function when: - the mu-slip curve is in the unstable region where Tb > Tr, and - other vehicle systems or internal brake functions are requesting an increase, a decrease, or both an increase and decrease in brake force at the wheel, but the command is issued for too long.
H1, H2, H6	The brake/stability control module allows the brake pressure to decrease at an individual wheel for the ABS function when: - the brake is not applied, and - other vehicle systems or internal brake functions are requesting a decrease in brake force at the wheel, but the command is issued for too long.
H2, H3, H6	The brake/stability control module allows the brake pressure to decrease at an individual wheel for the ABS function when: - the mu-slip curve is in the unstable region where Tb > Tr, and - the brake is applied, but the command is issued for too short a period.
H2, H3, H6	The brake/stability control module allows the brake pressure to decrease at an individual wheel for the ABS function when: - the mu-slip curve is in the unstable region where Tb > Tr, and - other vehicle systems or internal brake functions are requesting an increase, a decrease, or both an increase and decrease in brake force at the wheel, but the command is issued for too short a period.

Vehicle Level Hazard	**Unsafe Control Actions** **(Allow Hydraulic Pressure to Decrease at Individual Wheel for ABS Function)**
H2, H3, H6	The brake/stability control module allows the brake pressure to decrease at an individual wheel for the ABS function when: - the brake is not applied, and - other vehicle systems or internal brake functions are requesting a decrease in brake force at the wheel, but the command is issued for too short a period.
H1, H4	The brake/stability control module allows the brake pressure to decrease at an individual wheel for the ABS function when: - the mu-slip curve is in the stable region, at its peak, or in the unstable region where Tb < Tr, - the brake is not applied, and - other vehicle systems or internal brake functions are requesting a decrease in brake force at the wheel, but the command is issued for too short a period.
H1, H2, H6	The brake/stability control module allows the brake pressure to decrease at an individual wheel for the ABS function when: - the mu-slip curve is in the unstable region where Tb > Tr, and - the brake is applied, but the brake pressure is allowed to decrease by too much.
H1, H2, H6	The brake/stability control module allows the brake pressure to decrease at an individual wheel for the ABS function when: - the mu-slip curve is in the unstable region where Tb > Tr, and - other vehicle systems or internal brake functions are requesting an increase, a decrease, or both an increase and decrease in brake force at the wheel, but the brake pressure is allowed to decrease by too much.
H1, H2, H6	The brake/stability control module allows the brake pressure to decrease at an individual wheel for the ABS function when: - the brake is not applied, and - other vehicle systems or internal brake functions are requesting a decrease in brake force at the wheel, but the brake pressure is allowed to decrease by too much.
H2, H3, H6	The brake/stability control module allows the brake pressure to decrease at an individual wheel for the ABS function when: - the mu-slip curve is in the unstable region where Tb > Tr, and - the brake is applied, but the brake pressure is allowed to decrease by too little.

Vehicle Level Hazard	Unsafe Control Actions (Allow Hydraulic Pressure to Decrease at Individual Wheel for ABS Function)
H2, H3, H6	The brake/stability control module allows the brake pressure to decrease at an individual wheel for the ABS function when: - the mu-slip curve is in the unstable region where Tb > Tr, and - other vehicle systems or internal brake functions are requesting an increase, a decrease, or both an increase and decrease in brake force at the wheel, but the brake pressure is allowed to decrease by too little.
H2, H3, H6	The brake/stability control module allows the brake pressure to decrease at an individual wheel for the ABS function when: - the brake is not applied, and - other vehicle systems or internal brake functions are requesting a decrease in brake force at the wheel, but the brake pressure is allowed to decrease by too little.
H1, H4	The brake/stability control module allows the brake pressure to decrease at an individual wheel for the ABS function when: - the mu-slip curve is in the stable region, at its peak, or in the unstable region where Tb < Tr, - the brake is not applied, and - other vehicle systems or internal brake functions are requesting a decrease in brake force at the wheel, but the brake pressure is allowed to decrease by too little.
H1, H2, H3, H4, H6	The brake/stability control module correctly issues the command to allow the brake pressure to decrease at an individual wheel for the ABS function, but the command is executed incorrectly.
H2, H3, H6	The brake/stability control module allows the brake pressure to decrease at an individual wheel for the ABS function when: - the mu-slip curve is in the unstable region where Tb > Tr, and - the brake is applied, but the command is issued too late.
H2, H3, H6	The brake/stability control module allows the brake pressure to decrease at an individual wheel for the ABS function when: - the mu-slip curve is in the unstable region where Tb > Tr, and - other vehicle systems or internal brake functions are requesting an increase, a decrease, or both an increase and decrease in brake force at the wheel, but the command is issued too late.

Vehicle Level Hazard	Unsafe Control Actions (Allow Hydraulic Pressure to Decrease at Individual Wheel for ABS Function)
H2, H3, H6	The brake/stability control module allows the brake pressure to decrease at an individual wheel for the ABS function when: - the brake is not applied, and - other vehicle systems or internal brake functions are requesting a decrease in brake force at the wheel, but the command is issued too late.
H1, H4	The brake/stability control module allows the brake pressure to decrease at an individual wheel for the ABS function when: - the mu-slip curve is in the stable region, at its peak, or in the unstable region where Tb < Tr, - the brake is not applied, and - other vehicle systems or internal brake functions are requesting a decrease in brake force at the wheel, but the command is issued too late.

H1: Unintended Vehicle Lateral Motion / Unintended Yaw
H1B: Unintended Vehicle Lateral Motion / Unintended Yaw – Improper Resolution of Conflicting Commands
H2: Insufficient Vehicle Lateral Motion / Insufficient Yaw
H2B: Insufficient Vehicle Lateral Motion / Insufficient Yaw – Improper Resolution of Conflicting Commands
H3: Loss of Lateral Motion Control
H4: Unintended Vehicle Deceleration
H4B: Unintended Vehicle Deceleration – Improper Resolution of Conflicting Commands
H6: Insufficient Vehicle Deceleration

Table E-3: Unsafe Control Actions for the "Adjust Hydraulic Pressure at Wheels to Induce Yaw in θ Direction (ESC)" Control Action

Vehicle Level Hazard	**Unsafe Control Actions** **(Adjust Hydraulic Pressure at Wheels to Induce Yaw in θ Direction (ESC))**
H1, H2	The brake/stability control module does not adjust the hydraulic pressure at the wheels to induce yaw in the θ direction when: - the yaw error between the driver's command and the vehicle dynamics is in the θ direction.
H2	The brake/stability control module does not adjust the hydraulic pressure at the wheels to induce yaw in the θ direction when: - there is no yaw error between the driver's command and the vehicle dynamics, and - other vehicle systems or internal brake functions are requesting yaw/differential braking in the θ direction.
H1B, H2B	The brake/stability control module does not adjust the hydraulic pressure at the wheels to induce yaw in the θ direction when: - the yaw error between the driver's command and the vehicle dynamics is in the θ direction, and - other vehicle systems or internal brake functions are requesting yaw/differential braking in the -θ direction or are requesting yaw/differential braking in both the θ and -θ directions.
H2B	The brake/stability control module does not adjust the hydraulic pressure at the wheels to induce yaw in the θ direction when: - the driver is applying the brakes, - there is no yaw error between the driver's command and the vehicle dynamics, and - other vehicle systems or internal brake functions are requesting yaw/differential braking in the θ direction.
H2B	The brake/stability control module does not adjust the hydraulic pressure at the wheels to induce yaw in the θ direction when: - other vehicle systems or internal brake functions are requesting yaw/differential braking in both the θ and -θ directions.
H2B	The brake/stability control module does not adjust the hydraulic pressure at the wheels to induce yaw in the θ direction when: - the yaw error between the driver's command and the vehicle dynamics is in the -θ direction, and - other vehicle systems or internal brake functions are requesting yaw/differential braking in the θ direction.
H1B	The brake/stability control module adjusts the hydraulic pressure at the wheels to induce yaw in the θ direction when: - other vehicle systems or internal brake functions are requesting yaw/differential braking in both the θ and -θ directions.

Vehicle Level Hazard	Unsafe Control Actions (Adjust Hydraulic Pressure at Wheels to Induce Yaw in θ Direction (ESC))
H1B	The brake/stability control module adjusts the hydraulic pressure at the wheels to induce yaw in the θ direction when: - the yaw error between the driver's command and the vehicle dynamics is in the θ direction, and - other vehicle systems or internal brake functions are requesting yaw/differential braking in the -θ directions.
H1B	The brake/stability control module adjusts the hydraulic pressure at the wheels to induce yaw in the θ direction when: - the yaw error between the driver's command and the vehicle dynamics is in the -θ direction, and - other vehicle systems or internal brake functions are not requesting yaw/differential braking, or are requesting yaw/differential braking in the θ direction.
H1	The brake/stability control module adjusts the hydraulic pressure at the wheels to induce yaw in the θ direction when: - there is no yaw error between the driver's command and the vehicle dynamics, or the error is in the -θ direction, and - other vehicle systems or internal brake functions are not requesting yaw/differential braking, or are requesting yaw/differential braking in the -θ direction.
H1	The brake/stability control module adjusts the hydraulic pressure at the wheels to induce yaw in the θ direction when: - there is no yaw error between the driver's command and the vehicle dynamics, and - other vehicle systems or internal brake functions are requesting yaw/differential braking in the θ direction, but the command is provided for too long.
H1	The brake/stability control module adjusts the hydraulic pressure at the wheels to induce yaw in the θ direction when: - the yaw error between the driver's command and the vehicle dynamics is in the θ direction, and - other vehicle systems or internal brake functions are not requesting yaw/differential braking, or are requesting yaw/differential braking in the θ direction, but the command is provided for too long.
H2	The brake/stability control module adjusts the hydraulic pressure at the wheels to induce yaw in the θ direction when: - there is no yaw error between the driver's command and the vehicle dynamics, and - other vehicle systems or internal brake functions are requesting yaw/differential braking in the θ direction, but the command is provided for too short of a period.

Vehicle Level Hazard	Unsafe Control Actions (Adjust Hydraulic Pressure at Wheels to Induce Yaw in θ Direction (ESC))
H2	The brake/stability control module adjusts the hydraulic pressure at the wheels to induce yaw in the θ direction when: - the yaw error between the driver's command and the vehicle dynamics is in the θ direction, and - other vehicle systems or internal brake functions are not requesting yaw/differential braking, or are requesting yaw/differential braking in the θ direction, but the command is provided for too short of a period.
H1	The brake/stability control module adjusts the hydraulic pressure at the wheels to induce yaw in the θ direction when: - there is no yaw error between the driver's command and the vehicle dynamics, and - other vehicle systems or internal brake functions are requesting yaw/differential braking in the θ direction, but the hydraulic pressure is increased by too much.
H1	The brake/stability control module adjusts the hydraulic pressure at the wheels to induce yaw in the θ direction when: - the yaw error between the driver's command and the vehicle dynamics is in the θ direction, and - other vehicle systems or internal brake functions are not requesting yaw/differential braking, or are requesting yaw/differential braking in the θ direction, but the hydraulic pressure is increased by too much.
H2	The brake/stability control module adjusts the hydraulic pressure at the wheels to induce yaw in the θ direction when: - there is no yaw error between the driver's command and the vehicle dynamics, and - other vehicle systems or internal brake functions are requesting yaw/differential braking in the θ direction, but the hydraulic pressure is increased by too little.
H2	The brake/stability control module adjusts the hydraulic pressure at the wheels to induce yaw in the θ direction when: - the yaw error between the driver's command and the vehicle dynamics is in the θ direction, and - other vehicle systems or internal brake functions are not requesting yaw/differential braking, or are requesting yaw/differential braking in the θ direction, but the hydraulic pressure is increased by too little.
H1, H2, H4, H6	The brake/stability control module correctly issues the command to adjust the hydraulic pressure at the wheels to induce yaw in the θ direction, but the command is executed incorrectly.

Vehicle Level Hazard	Unsafe Control Actions (Adjust Hydraulic Pressure at Wheels to Induce Yaw in θ Direction (ESC))
H2	The brake/stability control module adjusts the hydraulic pressure at the wheels to induce yaw in the θ direction when: - there is no yaw error between the driver's command and the vehicle dynamics, and - other vehicle systems or internal brake functions are requesting yaw/differential braking in the θ direction, but the command is issued too late.
H2	The brake/stability control module adjusts the hydraulic pressure at the wheels to induce yaw in the θ direction when: - the yaw error between the driver's command and the vehicle dynamics is in the θ direction, and - other vehicle systems or internal brake functions are not requesting yaw/differential braking, or are requesting yaw/differential braking in the θ direction, but the command is issued too late.

H1: Unintended Vehicle Lateral Motion / Unintended Yaw
H1B: Unintended Vehicle Lateral Motion / Unintended Yaw – Improper Resolution of Conflicting Commands
H2: Insufficient Vehicle Lateral Motion / Insufficient Yaw
H2B: Insufficient Vehicle Lateral Motion / Insufficient Yaw – Improper Resolution of Conflicting Commands
H4: Unintended Vehicle Deceleration
H6: Insufficient Vehicle Deceleration

Table E-4: Unsafe Control Actions for the “Increase Hydraulic Pressure at Individual Wheel for Traction Control” Control Action

Vehicle Level Hazard	**Unsafe Control Actions** **(Increase Hydraulic Pressure at Individual Wheel for Traction Control)**
H1, H8	The brake/stability control module does not increase the hydraulic pressure to increase at an individual wheel to support the TC function when: - the mu-slip curve is in the unstable region where Te > Tr, and - either the driver or other vehicle systems are commanding acceleration.
H1, H4, H8	The brake/stability control module increases the hydraulic pressure at an individual wheel to support the TC function when: - the mu-slip curve is in the stable region, at it's peak, or in the unstable region where Te < Tr, and - either the driver or other vehicle systems are commanding acceleration.
H1, H4, H8	The brake/stability control module increases the hydraulic pressure at an individual wheel to support the TC function when: - the mu-slip curve is in the unstable region where Te > Tr, and - either the driver or other vehicle systems are commanding acceleration. but the hydraulic pressure is increased for too long.
H1, H8	The brake/stability control module increases the hydraulic pressure at an individual wheel to support the TC function when: - the mu-slip curve is in the unstable region where Te > Tr, and - either the driver or other vehicle systems are commanding acceleration. but the hydraulic pressure is increased for too short a period.
H1, H4, H8	The brake/stability control module increases the hydraulic pressure at an individual wheel to support the TC function when: - the mu-slip curve is in the unstable region where Te > Tr, and - either the driver or other vehicle systems are commanding acceleration. but the hydraulic pressure is increased by too much.
H1, H8	The brake/stability control module increases the hydraulic pressure at an individual wheel to support the TC function when: - the mu-slip curve is in the unstable region where Te > Tr, and - either the driver or other vehicle systems are commanding acceleration. but the hydraulic pressure is increased by too little.
H1, H4, H8	The brake/stability control module correctly issues the command to increase the hydraulic pressure to an individual wheel to support the TC function, but the command is executed incorrectly.

Vehicle Level Hazard	Unsafe Control Actions (Increase Hydraulic Pressure at Individual Wheel for Traction Control)
H1, H8	The brake/stability control module increases the hydraulic pressure at an individual wheel to support the TC function when: - the mu-slip curve is in the unstable region where Te > Tr, and - either the driver or other vehicle systems are commanding acceleration. but the command is issued too late.
H1, H4	The brake/stability control module increases the hydraulic pressure at an individual wheel to support the TC function when: - neither the driver or other vehicle systems are commanding acceleration.

H1: Unintended Vehicle Lateral Motion / Unintended Yaw
H4: Unintended Vehicle Deceleration
H8: Insufficient Vehicle Propulsion

Table E-5: Unsafe Control Actions for the "Decrease Hydraulic Pressure at Individual Wheel for Traction Control" Control Action

Vehicle Level Hazard	**Unsafe Control Actions** **(Decrease Hydraulic Pressure at Individual Wheel for Traction Control)**
H1, H4, H8	The brake/stability control module does not decrease the hydraulic pressure at an individual wheel to support the TC function when: - the mu-slip curve is in the stable region, at it's peak, or in the unstable region where Te < Tr, and - either the driver or other vehicle systems are commanding acceleration.
H1	The brake/stability control module decreases the hydraulic pressure at an individual wheel to support the TC function when: - the mu-slip curve is in the unstable region where Te > Tr, and - neither the driver nor other vehicle systems are commanding acceleration.
H1, H8	The brake/stability control module decreases the hydraulic pressure at an individual wheel to support the TC function when: - the mu-slip curve is in the unstable region where Te > Tr, and - either the driver or other vehicle systems are commanding acceleration.
H1, H4	The brake/stability control module decreases the hydraulic pressure at an individual wheel to support the TC function when: - the mu-slip curve is in the stable region, at it's peak, or in the unstable region where Te < Tr, and - neither the driver nor other vehicle systems are commanding acceleration, but the hydraulic pressure is decreased for too short of a period.
H1, H4, H8	The brake/stability control module decreases the hydraulic pressure at an individual wheel to support the TC function when: - the mu-slip curve is in the stable region, at it's peak, or in the unstable region where Te < Tr, and - either the driver or other vehicle systems are commanding acceleration, but the hydraulic pressure is decreased for too short of a period.
H1, H4	The brake/stability control module decreases the hydraulic pressure at an individual wheel to support the TC function when: - the mu-slip curve is in the stable region, at it's peak, or in the unstable region where Te < Tr, and - neither the driver nor other vehicle systems are commanding acceleration, but the hydraulic pressure is decreased by too little.
H1, H4, H8	The brake/stability control module decreases the hydraulic pressure at an individual wheel to support the TC function when: - the mu-slip curve is in the stable region, at it's peak, or in the unstable region where Te < Tr, and - either the driver or other vehicle systems are commanding acceleration, but the hydraulic pressure is decreased by too little.

Vehicle Level Hazard	**Unsafe Control Actions** **(Decrease Hydraulic Pressure at Individual Wheel for Traction Control)**
H1, H4, H8	The brake/stability control module correctly issues the command to decrease the hydraulic pressure to an individual wheel to support the TC function, but the command is executed incorrectly.
H1, H4	The brake/stability control module decreases the hydraulic pressure at an individual wheel to support the TC function when: - the mu-slip curve is in the stable region, at it's peak, or in the unstable region where Te < Tr, and - neither the driver nor other vehicle systems are commanding acceleration, but the command is issued too late.
H1, H4, H8	The brake/stability control module decreases the hydraulic pressure at an individual wheel to support the TC function when: - the mu-slip curve is in the stable region, at it's peak, or in the unstable region where Te < Tr, and - either the driver or other vehicle systems are commanding acceleration, but the command is issued too late.

H1: Unintended Vehicle Lateral Motion / Unintended Yaw
H4: Unintended Vehicle Deceleration
H8: Insufficient Vehicle Propulsion

Table E-6: Unsafe Control Actions for the "Increase Hydraulic Pressure to Increase Braking at All Wheels" Control Action

Vehicle Level Hazard	Unsafe Control Actions (Increase Hydraulic Pressure to Increase Braking at All Wheels)
H6	The brake / stability control module does not increase the hydraulic pressure to increase the braking force on all wheels when: - other vehicle systems or internal brake functions request an increase in braking on all wheels.
H6B	The brake / stability control module does not increase the hydraulic pressure to increase the braking force on all wheels when: - other vehicle systems or internal brake functions request both an increase and decrease in braking on all wheels, both an increase in braking on all wheels and yaw/differential braking, or both an increase and decrease in braking on all wheels and yaw/differential braking.
H4	The brake / stability control module increases the hydraulic pressure to increase the braking force on all wheels when: - other vehicle systems or internal brake functions do not request braking or request a decrease in braking on all wheels.
H2, H4	The brake / stability control module increases the hydraulic pressure to increase the braking force on all wheels when: - other vehicle systems or internal brake functions request yaw/differential braking, or both a decrease in braking on all wheels and yaw/differential braking.
H4B, H6B	The brake / stability control module increases the hydraulic pressure to increase the braking force on all wheels when: - other vehicle systems or internal brake functions request both an increase in braking on all wheels and yaw/differential braking, or both an increase and decrease in braking on all wheels and yaw/differential braking.
H4B	The brake / stability control module increases the hydraulic pressure to increase the braking force on all wheels when: - other vehicle systems or internal brake functions request both an increase and decrease in braking on all wheels.
H4	The brake / stability control module increases the hydraulic pressure to increase the braking force on all wheels when: - other vehicle systems or internal brake functions request an increase in braking on all wheels, but the command is issued for too long.
H6	The brake / stability control module increases the hydraulic pressure to increase the braking force on all wheels when: - other vehicle systems or internal brake functions request an increase in braking on all wheels, but the command is issued for too short of a period.

Vehicle Level Hazard	**Unsafe Control Actions** **(Increase Hydraulic Pressure to Increase Braking at All Wheels)**
H4	The brake / stability control module increases the hydraulic pressure to increase the braking force on all wheels when: - other vehicle systems or internal brake functions request an increase in braking on all wheels, but the hydraulic pressure is increased by too much.
H6	The brake / stability control module increases the hydraulic pressure to increase the braking force on all wheels when: - other vehicle systems or internal brake functions request an increase in braking on all wheels, but the hydraulic pressure is increased by too little.
H1, H4, H6	The brake / stability control module correctly issues the command to increase the hydraulic pressure to increase the braking force on all wheels, but the command is executed incorrectly.
H6	The brake / stability control module increases the hydraulic pressure to increase the braking force on all wheels when: - other vehicle systems or internal brake functions request an increase in braking on all wheels, but the command is issued too late.

H1: Unintended Vehicle Lateral Motion / Unintended Yaw
H2: Insufficient Vehicle Lateral Motion / Insufficient Yaw
H4: Unintended Vehicle Deceleration
H4B: Unintended Vehicle Deceleration – Improper Resolution of Conflicting Commands
H6: Insufficient Vehicle Deceleration
H6B: Insufficient Vehicle Deceleration – Improper Resolution of Conflicting Commands

Table E-7: Unsafe Control Actions for the "Decrease Hydraulic Pressure to Decrease Braking at All Wheels" Control Action

Vehicle Level Hazard	Unsafe Control Actions (Decrease Hydraulic Pressure to Decrease Braking at All Wheels)
H4	The brake / stability control module does not decrease the hydraulic pressure to decrease the braking force on all wheels when: - the driver is not applying the brakes, and - other vehicle systems or internal brake functions request a decrease in braking on all wheels.
H4B	The brake / stability control module does not decrease the hydraulic pressure to decrease the braking force on all wheels when: - the brake is applied, and - other vehicle systems or internal brake functions request a decrease in braking on all wheels.
H4B	The brake / stability control module does not decrease the hydraulic pressure to decrease the braking force on all wheels when: - other vehicle systems or internal brake functions request both an increase and decrease in braking on all wheels, both a decrease in braking on all wheels and yaw/differential braking, or both an increase and decrease in braking on all wheels and yaw/differential braking.
H2	The brake / stability control module decreases the hydraulic pressure to decrease the braking force on all wheels when: - other vehicle systems or internal brake functions request yaw/differential braking or both an increase in braking on all wheels and yaw/differential braking.
H6	The brake / stability control module decreases the hydraulic pressure to decrease the braking force on all wheels when: - the driver applies the brakes, and - other vehicle systems or internal brake functions do not request braking, request an increase in braking, or request yaw/differential braking.
H6	The brake / stability control module decreases the hydraulic pressure to decrease the braking force on all wheels when: - other vehicle systems or internal brake functions request both an increase in braking on all wheels and yaw/differential braking.
H2B	The brake / stability control module decreases the hydraulic pressure to decrease the braking force on all wheels when: - other vehicle systems or internal brake functions request both a decrease in braking on all wheels and yaw/differential braking, or both an increase and decrease in braking on all wheels and yaw/differential braking.

Vehicle Level Hazard	**Unsafe Control Actions** **(Decrease Hydraulic Pressure to Decrease Braking at All Wheels)**
H6B	The brake / stability control module decreases the hydraulic pressure to decrease the braking force on all wheels when: - the driver applies the brakes, and - other vehicle systems or internal brake functions request a decrease in braking, or request both a decrease in braking and yaw/differential braking.
H6B	The brake / stability control module decreases the hydraulic pressure to decrease the braking force on all wheels when: - other vehicle systems or internal brake functions request both an increase and decrease in braking on all wheels, or both an increase and decrease in braking and yaw/differential braking.
H6	The brake / stability control module decreases the hydraulic pressure to decrease the braking force on all wheels when: - the driver is not applying the brakes, and - other vehicle systems or internal brake functions request a decrease in braking on all wheels, but the command is issued for too long.
H4	The brake / stability control module decreases the hydraulic pressure to decrease the braking force on all wheels when: - the driver is not applying the brakes, and - other vehicle systems or internal brake functions request a decrease in braking on all wheels, but the command is issued for too short of a period.
H6	The brake / stability control module decreases the hydraulic pressure to decrease the braking force on all wheels when: - the driver is not applying the brakes, and - other vehicle systems or internal brake functions request a decrease in braking on all wheels, but the hydraulic pressure is decreased by too much.
H4	The brake / stability control module decreases the hydraulic pressure to decrease the braking force on all wheels when: - the driver is not applying the brakes, and - other vehicle systems or internal brake functions request a decrease in braking on all wheels, but the hydraulic pressure is decreased by too little.
H1, H4, H6	The brake / stability control module correctly issues the command to decrease the hydraulic pressure to decrease the braking force on all wheels, but the command is executed incorrectly.
H4	The brake / stability control module decreases the hydraulic pressure to decrease the braking force on all wheels when: - the driver is not applying the brakes, and - other vehicle systems or internal brake functions request a decrease in braking on all wheels, but the command is issued too late.

H1: Unintended Vehicle Lateral Motion / Unintended Yaw
H2: Insufficient Vehicle Lateral Motion / Insufficient Yaw
H2B: Insufficient Vehicle Lateral Motion / Insufficient Yaw – Improper Resolution of Conflicting Commands
H4: Unintended Vehicle Deceleration
H4B: Unintended Vehicle Deceleration – Improper Resolution of Conflicting Commands
H6: Insufficient Vehicle Deceleration
H6B: Insufficient Vehicle Deceleration – Improper Resolution of Conflicting Commands

Table E-8: Unsafe Control Actions for the "Request a Propulsion Torque Increase" Control Action

Vehicle Level Hazard	Unsafe Control Actions (Request a Propulsion Torque Increase)
H1, H2, H8, H10	The brake/stability control module does not request a torque increase when: - an increase in torque is required to support a brake function.
H6, H7	The brake/stability control module requests a torque increase when: - an increase in torque is not required to support a brake function.
H7, H8	The brake/stability control module requests a torque increase when: - an increase in torque is required to support a brake function, but the request is issued for too long.
H1, H2, H8, H10	The brake/stability control module requests a torque increase when: - an increase in torque is required to support a brake function, but the request is issued for too short of a period.
H6, H7	The brake/stability control module requests a torque increase when: - an increase in torque is required to support a brake function, but too much of a torque increase is requested.
H1, H2, H8, H10	The brake/stability control module requests a torque increase when: - an increase in torque is required to support a brake function, but too little of a torque increase is requested.
H1, H2, H6, H7, H8, H10	The brake / stability control module correctly requests a torque increase, but the command is executed incorrectly.
H6, H7	The brake/stability control module requests a torque increase when: - an increase in torque is required to support a brake function, but the command is issued too late.

H1: Unintended Vehicle Lateral Motion / Unintended Yaw
H2: Insufficient Vehicle Lateral Motion / Insufficient Yaw
H6: Insufficient Vehicle Deceleration
H7: Unintended Vehicle Propulsion
H8: Insufficient Vehicle Propulsion
H10: Propulsion Power Reduction/Loss or Vehicle Stalling

Table E-9: Unsafe Control Actions for the “Request a Propulsion Torque Reduction” Control Action

Vehicle Level Hazard	**Unsafe Control Actions** **(Request a Propulsion Torque Reduction)**
H8, H10	The brake/stability control module requests a torque decrease when: - a decrease in torque is required to support a brake function, but too much of a torque decrease is requested.
H1, H2, H6	The brake/stability control module requests a torque decrease when: - a decrease in torque is required to support a brake function, but too little of a torque decrease is requested.
H1, H2, H6, H8, H10	The brake/stability control module correctly requests a torque decrease, but the command is executed incorrectly.
H8, H10	The brake/stability control module requests a torque decrease when: - a decrease in torque is required to support a brake function, but the request is issued for too long
H1, H2, H6	The brake/stability control module requests a torque decrease when: - a decrease in torque is required to support a brake function, but the request is issued for too short of a period.
H1, H2, H6	The brake/stability control module requests a torque decrease when: - a decrease in torque is required to support a brake function, but the command is issued too late.
H1, H2, H6	The brake/stability control module does not request a torque decrease when: - a decrease in torque is required to support a brake function.
H8, H10	The brake/stability control module requests a torque decrease when: - a decrease in torque is not required to support a brake function.

H1: Unintended Vehicle Lateral Motion / Unintended Yaw
H2: Insufficient Vehicle Lateral Motion / Insufficient Yaw
H6: Insufficient Vehicle Deceleration
H8: Insufficient Vehicle Propulsion
H10: Propulsion Power Reduction/Loss or Vehicle Stalling

Table E-10: Unsafe Control Actions for the “Request a Steering Adjustment” Control Action

Vehicle Level Hazard	Unsafe Control Actions (Request a Steering Adjustment)
H1	The brake/stability control module requests a steering adjustment when: - a steering adjustment is not needed to support a braking function.
H1	The brake/stability control module requests a steering adjustment when: - a steering adjustment is needed to support a braking function, but too much steering is requested.
H1, H2	The brake/stability control module requests a steering adjustment when: - a steering adjustment is needed to support a braking function, but too little steering is requested.
H1, H2	The brake/stability control module correctly requests a steering adjustment, but the command is executed incorrectly.
H1	The brake/stability control module requests a steering adjustment when: - a steering adjustment is needed to support a braking function, but the command duration is too long (e.g., the steering command persists after exiting a split-mu surface).
H1, H2	The brake/stability control module requests a steering adjustment when: - a steering adjustment is needed to support a braking function, but the command duration is too short.
H1, H2	The brake/stability control module requests a steering adjustment when: - a steering adjustment is needed to support a braking function, but the command is issued too late.
H1, H2	The brake/stability control module does not request a steering adjustment when: - a steering adjustment is needed to support a braking function.

H1: Unintended Vehicle Lateral Motion / Unintended Yaw
H2: Insufficient Vehicle Lateral Motion / Insufficient Yaw

Table E-11: Unsafe Control Actions for the “Calculate the Vehicle Speed” Control Action

Vehicle Level Hazard	Unsafe Control Actions (Calculate the Vehicle Speed)
H1, H2, H4, H6, H7, H10	The brake/stability control module does not calculate the vehicle speed.
H1, H2, H4, H10	The brake/stability control module calculates a vehicle speed that is too high.
H1, H2, H6, H7	The brake/stability control module calculates a vehicle speed that is too low.
H1, H2, H4, H6, H7, H10	The brake/stability control module correctly calculates the vehicle speed, but the vehicle speed is incorrectly transmitted to the rest of the vehicle.
H1, H2, H4, H6, H7, H10	The brake/stability control module calculates the vehicle speed too late.

H1: Unintended Vehicle Lateral Motion / Unintended Yaw
H2: Insufficient Vehicle Lateral Motion / Insufficient Yaw
H4: Unintended Vehicle Deceleration
H6: Insufficient Vehicle Deceleration
H7: Unintended Vehicle Propulsion
H10: Propulsion Power Reduction/Loss or Vehicle Stalling

Table E-12: Unsafe Control Actions for the "Increase Application of the Brake Pedal" Control Action

Vehicle Level Hazard	**Unsafe Control Actions** **(Increase Application of the Brake Pedal)**
H4	The driver increases application of the brake pedal when: - an increase in braking is not needed.
H4	The driver increases application of the brake pedal when: - an increase in braking is needed, but the brake pedal position is increased by too much.
H6	The driver increases application of the brake pedal when: - an increase in braking is needed, but the brake pedal position is increased by too little.
H5, H6	The driver correctly increases application of the brake pedal, but the command is executed incorrectly.
H6	The driver increases application of the brake pedal when: - an increase in braking is needed, but the brakes are applied for too short a period.
H6	The driver increases application of the brake pedal when: - an increase in braking is needed, but the brakes are applied too late.
H6	The driver does not increase application of the brake pedal when: - an increase in braking is needed.

H4: Unintended Vehicle Deceleration
H6: Insufficient Vehicle Deceleration

Table E-13: Unsafe Control Actions for the “Decrease Application of the Brake Pedal” Control Action

Vehicle Level Hazard	Unsafe Control Actions (Decrease Application of the Brake Pedal)
H6	The driver decreases the angular position of the brake pedal when: - a reduction in braking is not needed.
H6	The driver decreases the angular position of the brake pedal when: - a reduction in braking is needed, but the brake pedal angular position is reduced by too much.
H4	The driver correctly decreases the angular position of the brake pedal, but the command is executed incorrectly.
H6	The driver reduces the angular position of the brake pedal when: - a reduction in braking is needed, but the brakes are released too soon.

H4: Unintended Vehicle Deceleration
H6: Insufficient Vehicle Deceleration

Table E-14: Unsafe Control Actions for the "Disable Stability Control" Control Action

Vehicle Level Hazard	**Unsafe Control Actions** **(Disable Stability Control)**
H1, H10	The driver presses the button to disable stability control when: - the stability control system is already disabled.
H1, H10	The driver presses the button to disable stability control when: - the stability control system is enabled, but the button is pressed with too much force.
H1, H10	The driver presses the button to disable stability control when: - the stability control system is enabled, but the button is pressed with too little force.
H1, H10	The driver correctly presses the button to disable stability control, but the command is executed incorrectly.
H1, H10	The driver presses the button to disable stability control when: - the stability control system is enabled, but the button is pressed for too short a period (e.g., doesn't activate).
H1, H10	The driver presses the button to disable stability control when: - the stability control system is enabled, but the button is pressed for too long (e.g., button cycles through modes).

H1: Unintended Vehicle Lateral Motion / Unintended Yaw
H10: Propulsion Power Reduction/Loss or Vehicle Stalling

Table E-15: Unsafe Control Actions for the “Enable Stability Control” Control Action

Vehicle Level Hazard	**Unsafe Control Actions** **(Enable Stability Control)**
H1, H2	The driver presses the button to enable stability control when: - the stability control system is already enabled.
H1, H2	The driver presses the button to enable stability control when: - the stability control system is disabled, but the button is pressed with too much force.
H1, H2	The driver presses the button to enable stability control when: - the stability control system is disabled, but the button is pressed with too little force.
H1, H2	The driver correctly presses the button to enable stability control, but the command is executed incorrectly.
H1, H2	The driver presses the button to enable stability control when: - the stability control system is disabled, but the button is pressed for too short a period (e.g., doesn't activate system).
H1, H2	The driver presses the button to enable stability control when: - the stability control system is disabled, but the button is pressed for too long (e.g., cycles through modes).

H1: Unintended Vehicle Lateral Motion / Unintended Yaw
H2: Insufficient Vehicle Lateral Motion / Insufficient Yaw

APPENDIX F: OPERATIONAL SITUATIONS

1. Vehicle in a parking lot or drive way and starting to move; good road conditions; pedestrians present. Driver brakes.
2. Vehicle in a parking lot or drive way and starts moving; good road conditions; pedestrian presence; driver brakes hard.
3. Vehicle in a parking lot or drive and starts moving; wet or snowy road; pedestrians present.
4. Vehicle in a parking lot or drive and starts moving; wet or snowy road; pedestrians present. Driver brakes.
5. Vehicle in a parking lot or drive way and starts moving; wet or snowy road; pedestrians present; the driver brakes hard.
6. Vehicle in a parking lot or drive and starts moving; split Mu road; pedestrians present.
7. Vehicle in a parking lot or drive way and starting to move; split Mu road; pedestrians present. Driver brakes.
8. Vehicle in a parking lot or drive way and starts moving; split Mu road; pedestrians present; driver brakes hard.
9. Vehicle going in reverse from a stopped condition at (relatively) low speed; other vehicles present (stopped or moving at low speed); slippery/good road conditions; pedestrians present; the vehicle brakes hard.
10. Driving inside the city with light/heavy traffic; pedestrians present; stop and go driving, good road conditions. The driver brakes.
11. Driving inside the city with light/heavy traffic; pedestrians present, stop and go driving, good road conditions; the driver brakes hard.
12. Driving inside the city with light/ heavy traffic; pedestrians present, stop and go driving, wet or snowy road conditions.
13. Driving inside the city with light/heavy traffic; pedestrians present, stop and go driving, wet or snowy road conditions; the vehicle brakes hard.
14. Driving inside the city with light/heavy traffic; pedestrians present, stop and go driving, wet or snowy road conditions; vehicle in evasive maneuver with hard braking.
15. Driving inside the city with light/ heavy traffic; pedestrians present, stop and go driving, split Mu road conditions. The diver brakes
16. Driving inside the city with light/ heavy traffic; pedestrians present, stop and go driving, split Mu road conditions; the driver brakes hard.
17. Driving inside the city with light/ heavy traffic; pedestrians present, stop and go driving, split Mu road conditions; vehicle in evasive maneuver with hard braking.
18. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; the vehicle brakes hard.
19. Driving inside the city (< 40 kph) with heavy traffic and heavy pedestrians present; good road conditions. Moderate road bends; the vehicle brakes hard.

20. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver with hard braking.
21. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle steers sharply.
22. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. The vehicle brakes hard.
23. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver with hard braking
24. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. The vehicle steers sharply.
25. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends. The vehicle brakes hard.
26. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver with hard braking
27. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. The vehicle steers sharply.
28. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the vehicle brakes hard.
29. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver with hard braking.
30. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle steers sharply.
31. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. The vehicle brakes hard.
32. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver with hard braking
33. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrian presence, wet or snowy road conditions. Sharp road bends. The vehicle steers sharply.
34. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends. The vehicle brakes hard.
35. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver with hard braking
36. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. The vehicle steers sharply.

37. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; the driver brakes hard.
38. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver with hard braking.
39. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; the driver steers sharply.
40. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. The driver brakes hard.
41. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver with hard braking
42. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. The driver steers sharply.
43. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver with hard braking
44. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate bends; the driver steers sharply.
45. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the driver brakes hard.
46. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver with hard braking.
47. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the driver steers sharply.
48. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. The driver brakes hard.
49. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver with hard braking
50. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. Sharp road bends. The driver steers sharply.
51. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends. The vehicle brakes hard.

52. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver with hard braking
53. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. The driver steers sharply.
54. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; the vehicle brakes hard.
55. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver with hard braking.
56. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle steers sharply.
57. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. The vehicle brakes hard.
58. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver with hard braking
59. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. The vehicle steers sharply.
60. Driving at high speed (100 kph < V < 130 kph) with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends. The vehicle brakes hard.
61. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver with hard braking
62. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. The vehicle steers sharply.
63. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the vehicle brakes hard.
64. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver with hard braking.
65. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle steers sharply.
66. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. The vehicle brakes hard.

67. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver with hard braking
68. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. Sharp road bends. The vehicle steers sharply.
69. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends. The vehicle brakes hard.
70. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver with hard braking
71. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. The vehicle steers sharply.
72. Driving at very high speed (V > 130 kph) with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; the vehicle brakes hard.
73. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver with hard braking.
74. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle steers sharply.
75. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. The vehicle brakes hard.
76. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver with hard braking
77. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. The vehicle steers sharply.
78. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends. The vehicle brakes hard.
79. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver with hard braking
80. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. The vehicle steers sharply.
81. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the vehicle brakes hard.
82. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver with hard braking.

83. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle steers sharply.
84. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. The vehicle brakes hard.
85. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver with hard braking
86. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. Sharp road bends. The vehicle steers sharply.
87. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends. The vehicle brakes hard.
88. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver with hard braking
89. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. The vehicle steers sharply.
90. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; driver brakes hard.
91. Driving inside the city with light/heavy traffic; pedestrians present, stop and go driving, wet or snowy road conditions; the vehicle brakes.
92. Driving inside the city with light/heavy traffic; pedestrians present, stop and go driving, wet or snowy road conditions; vehicle in evasive maneuver with braking.
93. Driving inside the city with light/ heavy traffic; pedestrians present, stop and go driving, split Mu road conditions. The vehicle brakes
94. Driving inside the city with light/ heavy traffic; pedestrians present, stop and go driving, split Mu road conditions; the vehicle brakes hard.
95. Driving inside the city with light/ heavy traffic; pedestrians present, stop and go driving, split Mu road conditions; vehicle in evasive maneuver with braking.
96. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; the vehicle brakes.
97. Driving inside the city (< 40 kph) with heavy traffic and heavy pedestrians present; good road conditions. Moderate road bends; the vehicle brakes.
98. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver with braking.
99. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver with braking
100. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver with braking
101. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver with braking

102. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; the vehicle brakes.
103. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver with braking.
104. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. The driver brakes.
105. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver with braking
106. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions, moderate road bends. The driver steers sharply.
107. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver with braking
108. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the driver brakes.
109. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver with braking.
110. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. The vehicle brakes.
111. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver with braking.
112. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver with braking
113. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle brakes.
114. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. The vehicle brakes.
115. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver with braking
116. Driving at high speed (100 kph < V < 130 kph) with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends. The vehicle brakes.

117. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver with braking
118. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the vehicle brakes.
119. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver with braking.
120. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. The vehicle brakes.
121. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver with braking
122. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends. The vehicle brakes.
123. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver with braking.
124. Driving at very high speed (V > 130 kph) with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; the vehicle brakes.
125. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver with braking.
126. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. The vehicle brakes.
127. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver with braking
128. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends. The vehicle brakes.
129. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver with braking
130. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the vehicle brakes.
131. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver with braking.
132. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. The vehicle brakes.

133. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver with braking.
134. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends. The vehicle brakes.
135. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver with braking.
136. Vehicle in a parking lot or drive way and starting to move; good road conditions; pedestrians present.
137. Vehicle going in reverse from a stopped condition at (relatively) low speed; other vehicles present (stopped or moving at low speed); slippery/good road conditions; pedestrians present;
138. Driving inside the city with light/heavy traffic; pedestrians present; stop and go driving, good road conditions.
139. Driving inside the city with light/heavy traffic; pedestrians present, stop and go driving, wet or snowy road conditions; vehicle in evasive maneuver.
140. Driving inside the city with light/ heavy traffic; pedestrians present, stop and go driving, split Mu road conditions.
141. Driving inside the city with light/ heavy traffic; pedestrians present, stop and go driving, split Mu road conditions; vehicle in evasive maneuver.
142. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends;
143. Driving inside the city (< 40 kph) with heavy traffic and heavy pedestrians present; good road conditions. Moderate road bends.
144. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver.
145. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends.
146. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver.
147. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends.
148. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver
149. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends.
150. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver.

151. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends.
152. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver
153. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends.
154. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver.
155. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends;
156. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver.
157. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends.
158. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver.
159. Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends.
160. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver.
161. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver.
162. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends.
163. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver.
164. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends.
165. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver.
166. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends;
167. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends.

168. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver.
169. Driving at high speed (100 kph < V < 130 kph) with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends
170. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver.
171. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends.
172. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver.
173. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver.
174. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends.
175. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver.
176. Driving at very high speed (V > 130 kph) with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends.
177. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver.
178. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends.
179. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver.
180. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends.
181. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver.
182. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the vehicle.
183. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver.
184. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver.
185. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends.

186. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver.
187. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends.
188. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends.
189. Vehicle Parked
190. Vehicle in traffic, on an incline, facing downward; pedestrian presence,
191. Vehicle in traffic, on an incline, facing downward; negligible pedestrian presence.
192. Vehicle in traffic, on an incline, facing upward; pedestrian presence.
193. Vehicle in traffic, on an incline, facing upward; negligible pedestrian presence.
194. Vehicle stopped in traffic on high incline with unsecured steep slop
195. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, good road conditions. Overtaking maneuver
196. Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet/snow or split MU road conditions. Overtaking maneuver
197. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends.
198. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, good road conditions. Sharp road bends. Overtaking maneuver.
199. Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet/snow or split Mu road conditions. Overtaking maneuver.
200. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, good road conditions. Overtaking maneuver
201. Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet/snow or split MU road conditions. Overtaking maneuver

APPENDIX G: ASIL ASSESSMENT

Table G-1: Unintended Vehicle Lateral Motion / Unintended Yaw

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Unintended Vehicle Lateral Motion/Yaw)			
			E	S	C	ASIL
Complete loss of function will likely result in lock-up of the wheels and the associated loss of steering, stability, and deceleration control.	Vehicle in a parking lot or drive way and starting to move; good road conditions; pedestrians present. Driver brakes.	None.	E4	S2	C0	
	Vehicle in a parking lot or drive way and starts moving; good road conditions; pedestrian presence; driver brakes hard.	The vehicle runs into a pedestrian at low speed.	E4	S2	C0	
	Vehicle in a parking lot or drive and starts moving; wet or snowy road; pedestrians present. Driver brakes.	The vehicle runs into a pedestrian at low speed.	E2	S2	C0	
	Vehicle in a parking lot or drive way and starts moving; wet or snowy road; pedestrians present; the driver brakes hard.	The vehicle runs into a pedestrian at low speed.	E2	S2	C0	
	Vehicle in a parking lot or drive way and starting to move; split Mu road; pedestrians present. Driver brakes.	The vehicle runs into a pedestrian at low speed.	E2	S2	C0	
	Vehicle in a parking lot or drive way and starts moving; split Mu road; pedestrians present; driver brakes hard.	The vehicle runs into a pedestrian at low speed.	E2	S2	C0	
	Vehicle going in reverse from a stopped condition at (relatively) low speed; other vehicles present (stopped or moving at low speed); slippery/good road conditions; pedestrians present; the vehicle brakes hard.	The vehicle runs into a pedestrian at low speed.	E2	S2	C0	
	Driving inside the city with light/heavy traffic; pedestrians present, stop and go driving, good road conditions; the driver brakes hard.	The vehicle runs into a vehicle or pedestrian at low speed.	E4	S2	C0	

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Unintended Vehicle Lateral Motion/Yaw)			
			E	S	C	ASIL
	Driving inside the city with light/heavy traffic; pedestrians present, stop and go driving, wet or snowy road conditions; the vehicle brakes hard.	The vehicle runs into a vehicle or pedestrian at low speed.	E2	S2	C0	
	Driving inside the city with light/heavy traffic; pedestrians present, stop and go driving, wet or snowy road conditions; vehicle in evasive maneuver with hard braking.	The vehicle runs into a vehicle or pedestrian at low speed.	E1	S2	C0	
	Driving inside the city with light/ heavy traffic; pedestrians present, stop and go driving, split Mu road conditions. The diver vehicle brakes	The vehicle runs into a vehicle or pedestrian at low speed.	E2	S2	C0	
	Driving inside the city with light/ heavy traffic; pedestrians present, stop and go driving, split Mu road conditions; the driver brakes hard.	The vehicle runs into a vehicle or pedestrian at low speed.	E2	S2	C0	
	Driving inside the city with light/ heavy traffic; pedestrians present, stop and go driving, split Mu road conditions; vehicle in evasive maneuver with hard braking.	The vehicle runs into a vehicle or pedestrian at low speed.	E1	S2	C0	
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; the vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E4	S1	C0	
	Driving inside the city (< 40 kph) with heavy traffic and heavy pedestrians present; good road conditions. Moderate road bends; the vehicle brakes hard.	The vehicle runs into a pedestrian or another vehicle or barrier.	E4	S2	C0	
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver with hard braking.	The vehicle runs into another vehicle or barrier.	E2	S2	C0	

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Unintended Vehicle Lateral Motion/Yaw)			
			E	S	C	ASIL
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present; good road conditions. Moderate road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S2	C0	
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, wet or snowy road conditions; moderate road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S2	C0	
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S2	C0	
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, wet or snowy road conditions; moderate road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S2	C0	
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, split Mu road conditions; moderate road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S2	C0	
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S2	C0	
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, split MU road conditions; moderate road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S2	C0	
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present; good road conditions. Sharp road bends; the vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S2	C0	

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Unintended Vehicle Lateral Motion/Yaw)			
			E	S	C	ASIL
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver with hard braking.	The vehicle runs into another vehicle or barrier.	E2	S2	C0	
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present; good road conditions. Sharp road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S2	C0	
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, wet or snowy road conditions; Sharp road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S2	C0	
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E1	S2	C0	
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, wet or snowy road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S2	C0	
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, split Mu road conditions. Sharp road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S2	C0	
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E1	S2	C0	
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, split MU road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S2	C0	

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Unintended Vehicle Lateral Motion/Yaw)			
			E	S	C	ASIL
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; the driver brakes hard.	The vehicle runs into another vehicle or barrier.	E4	S3	C1	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver with hard braking.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; the driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. The driver brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. The driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Unintended Vehicle Lateral Motion/Yaw)			
			E	S	C	ASIL
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate bends; The driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the driver brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver with hard braking.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. The driver brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Unintended Vehicle Lateral Motion/Yaw)			
			E	S	C	ASIL
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. Sharp road bends. The driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. The driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; driver brakes hard.	The vehicle runs into another vehicle or barrier.	E4	S3	C1	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Unintended Vehicle Lateral Motion/Yaw)			
			E	S	C	ASIL
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph) with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver with hard braking.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Unintended Vehicle Lateral Motion/Yaw)			
			E	S	C	ASIL
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A
	Driving at very high speed (V > 130 kph) with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; the vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Unintended Vehicle Lateral Motion/Yaw)			
			E	S	C	ASIL
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver with hard braking.	The vehicle runs into another vehicle or barrier.	E3	S3	C2	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Unintended Vehicle Lateral Motion/Yaw)			
			E	S	C	ASIL
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver with hard braking.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Unintended Vehicle Lateral Motion/Yaw)			
			E	S	C	ASIL
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A

Table G-2: Insufficient Vehicle Lateral Motion / Insufficient Yaw

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Lateral Motion/Yaw)			
			E	S	C	ASIL
The vehicle moves laterally, but less than or at a slower rate than what is commanded by the driver or another vehicle system controller.	Vehicle in a parking lot or drive way and starting to move; good road conditions; pedestrians present. Driver brakes.	None.	E4	S2	C0	
	Vehicle in a parking lot or drive way and starts moving; good road conditions; pedestrian presence; driver brakes hard.	The vehicle runs into a pedestrian at low speed.	E4	S2	C0	
	Vehicle in a parking lot or drive and starts moving; wet or snowy road; pedestrians present.	The vehicle wheel spins. No substantial vehicle movement from its place.	E2	S2	C1	QM
	Vehicle in a parking lot or drive and starts moving; wet or snowy road; pedestrians present. Driver brakes.	The vehicle runs into a pedestrian at low speed.	E2	S2	C0	
	Vehicle in a parking lot or drive way and starts moving; wet or snowy road; pedestrians present; the driver brakes hard.	The vehicle runs into a pedestrian at low speed.	E2	S2	C1	QM
	Vehicle in a parking lot or drive and starts moving; split Mu road; pedestrians present.	The vehicle wheel spins. No substantial vehicle movement from its place.	E2	S2	C1	QM
	Vehicle in a parking lot or drive way and starting to move; split Mu road; pedestrians present. Driver brakes.	The vehicle runs into a pedestrian at low speed.	E2	S2	C0	
	Vehicle in a parking lot or drive way and starts moving; split Mu road; pedestrians present; driver brakes hard.	The vehicle runs into a pedestrian at low speed.	E2	S2	C1	QM
	Vehicle going in reverse from a stopped condition at (relatively) low speed; other vehicles present (stopped or moving at low speed); slippery/good road conditions; pedestrians present; the vehicle brakes hard.	The vehicle runs into a pedestrian at low speed.	E2	S2	C1	QM

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Lateral Motion/Yaw)			
			E	S	C	ASIL
	Driving inside the city with light/heavy traffic; pedestrians present; stop and go driving, good road conditions. The driver brakes.	The vehicle runs into a vehicle or pedestrian at low speed.	E4	S2	C0	
	Driving inside the city with light/heavy traffic; pedestrians present, stop and go driving, good road conditions; the driver brakes hard.	The vehicle runs into a vehicle or pedestrian at low speed.	E4	S2	C0	
	Driving inside the city with light/ heavy traffic; pedestrians present, stop and go driving, wet or snowy road conditions.	The vehicle wheel spins.	E2	S2	C1	QM
	Driving inside the city with light/heavy traffic; pedestrians present, stop and go driving, wet or snowy road conditions; the vehicle brakes hard.	The vehicle runs into a vehicle or pedestrian at low speed.	E2	S2	C1	QM
	Driving inside the city with light/heavy traffic; pedestrians present, stop and go driving, wet or snowy road conditions; vehicle in evasive maneuver with hard braking.	The vehicle runs into a vehicle or pedestrian at low speed.	E1	S2	C1	QM
	Driving inside the city with light/ heavy traffic; pedestrians present, stop and go driving, split Mu road conditions. The diver vehicle brakes	The vehicle runs into a vehicle or pedestrian at low speed.	E2	S2	C0	
	Driving inside the city with light/ heavy traffic; pedestrians present, stop and go driving, split Mu road conditions; the driver brakes hard.	The vehicle runs into a vehicle or pedestrian at low speed.	E2	S2	C1	QM
	Driving inside the city with light/ heavy traffic; pedestrians present, stop and go driving, split Mu road conditions; vehicle in evasive maneuver with hard braking.	The vehicle runs into a vehicle or pedestrian at low speed.	E1	S2	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; the vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E4	S1	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and heavy pedestrians present; good road conditions. Moderate road bends; the vehicle brakes hard.	The vehicle runs into a pedestrian or another vehicle or barrier.	E4	S2	C1	A

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Lateral Motion/Yaw)			
			E	S	C	ASIL
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver with hard braking.	The vehicle runs into another vehicle or barrier.	E2	S2	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present; good road conditions. Moderate road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S2	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, wet or snowy road conditions; moderate road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S2	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S2	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, wet or snowy road conditions; moderate road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S2	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, split Mu road conditions; moderate road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S2	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S2	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, split MU road conditions; moderate road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S2	C1	QM

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Lateral Motion/Yaw)			
			E	S	C	ASIL
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S2	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver with hard braking.	The vehicle runs into another vehicle or barrier.	E2	S2	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present; good road conditions. Sharp road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S2	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, wet or snowy road conditions; Sharp road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S2	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E1	S2	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, wet or snowy road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S2	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, split Mu road conditions. Sharp road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S2	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E1	S2	C1	QM

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Lateral Motion/Yaw)			
			E	S	C	ASIL
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, split MU road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S2	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; the driver brakes hard.	The vehicle runs into another vehicle or barrier.	E4	S3	C1	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver with hard braking.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; the driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. The driver brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. The driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Lateral Motion/Yaw)			
			E	S	C	ASIL
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate bends; The driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the driver brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver with hard braking.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. The driver brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Lateral Motion/Yaw)			
			E	S	C	ASIL
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E1	S3	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. Sharp road bends. The driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E1	S3	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. The driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; the vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E4	S3	C1	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver with hard braking.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Lateral Motion/Yaw)			
			E	S	C	ASIL
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at high speed (100 kph < V < 130 kph) with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Lateral Motion/Yaw)			
			E	S	C	ASIL
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver with hard braking.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E1	S3	C2	QM
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E1	S3	C2	QM

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Lateral Motion/Yaw)			
			E	S	C	ASIL
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at very high speed (V > 130 kph) with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; the vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E3	S3	C2	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver with hard braking.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Lateral Motion/Yaw)			
			E	S	C	ASIL
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver with hard braking.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Lateral Motion/Yaw)			
			E	S	C	ASIL
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Table G-3: Loss of Lateral Motion Control

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Loss of Lateral Motion Control)			
			E	S	C	ASIL
Failure in TSC or ESC function (Stability Assist Functions) Could also be wheel lock preventing ability to steer.	Vehicle in a parking lot or drive way and starting to move; good road conditions; pedestrians present.	None.	E4	S2	C1	A
	Vehicle in a parking lot or drive and starts moving; wet or snowy road; pedestrians present.	The vehicle wheel spins. No substantial vehicle movement from its place.	E2	S2	C1	QM
	Vehicle in a parking lot or drive and starts moving; split Mu road; pedestrians present.	The vehicle wheel spins. No substantial vehicle movement from its place.	E2	S2	C1	QM
	Vehicle going in reverse from a stopped condition at (relatively) low speed; other vehicles present (stopped or moving at low speed); slippery/good road conditions; pedestrians present.	The vehicle runs into a pedestrian at low speed.	E2	S2	C1	QM
	Driving inside the city with light/heavy traffic; pedestrians present; stop and go driving, good road conditions.	The vehicle runs into a vehicle or pedestrian at low speed.	E4	S2	C1	A
	Driving inside the city with light/ heavy traffic; pedestrians present, stop and go driving, wet or snowy road conditions.	The vehicle wheel spins.	E2	S2	C1	QM
	Driving inside the city with light/heavy traffic; pedestrians present, stop and go driving, wet or snowy road conditions; vehicle in evasive maneuver.	The vehicle runs into a vehicle or pedestrian at low speed.	E1	S2	C1	QM
	Driving inside the city with light/ heavy traffic; pedestrians present, stop and go driving, split Mu road.	The vehicle runs into a vehicle or pedestrian at low speed.	E2	S2	C1	QM
	Driving inside the city with light/ heavy traffic; pedestrians present, stop and go driving, split Mu road conditions; vehicle in evasive maneuver.	The vehicle runs into a vehicle or pedestrian at low speed.	E1	S2	C1	QM

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Loss of Lateral Motion Control)			
			E	S	C	ASIL
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends.	The vehicle runs into another vehicle or barrier.	E4	S1	C2	A
	Driving inside the city (< 40 kph) with heavy traffic and heavy pedestrians present; good road conditions. Moderate road bends.	The vehicle runs into a pedestrian or another vehicle or barrier.	E4	S2	C2	B
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S2	C2	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S2	C2	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends.	The vehicle runs into another vehicle or barrier.	E2	S2	C2	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S2	C3	A
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S2	C2	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends.	The vehicle runs into another vehicle or barrier.	E2	S2	C2	QM

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Loss of Lateral Motion Control)			
			E	S	C	ASIL
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S2	C3	A
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S2	C2	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends.	The vehicle runs into another vehicle or barrier.	E2	S2	C2	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S2	C3	A
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S2	C2	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends.	The vehicle runs into another vehicle or barrier.	E2	S2	C2	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E1	S2	C3	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrian's present, wet or snowy road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S2	C2	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends.	The vehicle runs into another vehicle or barrier.	E2	S2	C2	QM

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Loss of Lateral Motion Control)			
			E	S	C	ASIL
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E1	S2	C3	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S2	C2	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends.	The vehicle runs into another vehicle or barrier.	E4	S3	C3	D
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; the driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. The driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Loss of Lateral Motion Control)			
			E	S	C	ASIL
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate bends; The driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Loss of Lateral Motion Control)			
			E	S	C	ASIL
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. Sharp road bends. The driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. The driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends;	The vehicle runs into another vehicle or barrier.	E4	S3	C3	D
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Loss of Lateral Motion Control)			
			E	S	C	ASIL
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph) with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Loss of Lateral Motion Control)			
			E	S	C	ASIL
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph) with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends.	The vehicle runs into another vehicle or barrier.	E3	S3	C3	C
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Loss of Lateral Motion Control)			
			E	S	C	ASIL
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Loss of Lateral Motion Control)			
			E	S	C	ASIL
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Table G-4: Unintended Vehicle Deceleration

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Unintended Vehicle Deceleration)			
			E	S	C	ASIL
Excessive braking resulting also in un-intended deceleration.	Vehicle in a parking lot or drive way and starting to move; good road conditions; pedestrians present. Driver brakes.	No accident scenario.	E4	S0		
	Vehicle in a parking lot or drive and starts moving; wet or snowy road; pedestrians present. Driver brakes.	Hits a pedestrian	E2	S2	C0	
	Vehicle in a parking lot or drive way and starting to move; split Mu road; pedestrians present. Driver brakes.	The vehicle runs into a pedestrian at low speed.	E2	S2	C0	
	Vehicle going in reverse from a stopped condition at (relatively) low speed; other vehicles present (stopped or moving at low speed); slippery/good road conditions; pedestrians present; the vehicle brakes hard.	The vehicle runs into a pedestrian at low speed.	E2	S2	C0	
	Driving inside the city with light/heavy traffic; pedestrians present; stop and go driving, good road conditions. The driver brakes.	Vehicle is rear-ended at low speed	E4	S1	C1	QM
	Driving inside the city with light/heavy traffic; pedestrians present, stop and go driving, wet or snowy road conditions; the vehicle brakes.	Vehicle is rear-ended at low speed	E2	S1	C1	QM
	Driving inside the city with light/heavy traffic; pedestrians present, stop and go driving, wet or snowy road conditions; vehicle in evasive maneuver with braking.	Vehicle is rear-ended at low speed	E1	S1	C1	QM
	Driving inside the city with light/ heavy traffic; pedestrians present, stop and go driving, split Mu road conditions. The vehicle brakes	Vehicle is rear-ended at low speed	E2	S1	C1	QM
	Driving inside the city with light/ heavy traffic; pedestrians present, stop and go driving, split Mu road conditions; the vehicle brakes hard.	Vehicle is rear-ended at low speed	E2	S1	C1	QM

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Unintended Vehicle Deceleration)			
			E	S	C	ASIL
	Driving inside the city with light/ heavy traffic; pedestrians present, stop and go driving, split Mu road conditions; vehicle in evasive maneuver with braking.	Vehicle is rear-ended at low speed	E1	S1	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; the vehicle brakes.	The vehicle runs into another vehicle or barrier.	E4	S1	C2	A
	Driving inside the city (< 40 kph) with heavy traffic and heavy pedestrians present; good road conditions. Moderate road bends; the vehicle brakes.	The vehicle runs into another vehicle or barrier.	E4	S1	C2	A
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver with braking.	The vehicle runs into another vehicle or barrier.	E2	S1	C2	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S1	C2	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S1	C2	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver with braking	The vehicle runs into another vehicle or barrier.	E2	S1	C2	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S1	C2	QM

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Unintended Vehicle Deceleration)			
			E	S	C	ASIL
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S1	C2	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S1	C2	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S1	C2	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S1	C2	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver with hard braking.	The vehicle runs into another vehicle or barrier.	E2	S1	C2	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S1	C2	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S1	C2	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver with braking	The vehicle runs into another vehicle or barrier.	E1	S1	C2	QM

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Unintended Vehicle Deceleration)			
			E	S	C	ASIL
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, wet or snowy road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S1	C2	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S1	C2	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver with braking	The vehicle runs into another vehicle or barrier.	E1	S1	C2	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E1	S1	C2	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; the vehicle brakes.	The vehicle runs into another vehicle or barrier.	E4	S3	C2	C
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver with braking.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; the driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. The driver brakes.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Unintended Vehicle Deceleration)			
			E	S	C	ASIL
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver with braking	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions, moderate road bends. The driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver with braking	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate bends; The driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the driver brakes.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver with braking.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Unintended Vehicle Deceleration)			
			E	S	C	ASIL
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. The vehicle brakes.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver with braking.	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. Sharp road bends. The driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver with braking	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. The driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Unintended Vehicle Deceleration)			
			E	S	C	ASIL
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle brakes.	The vehicle runs into another vehicle or barrier.	E4	S3	C3	D
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. The vehicle brakes.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver with braking	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph) with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends. The vehicle brakes.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver with braking	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Unintended Vehicle Deceleration)			
			E	S	C	ASIL
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the vehicle brakes.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver with braking.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. The vehicle brakes.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver with braking	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends. The vehicle brakes.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver with braking.	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Unintended Vehicle Deceleration)			
			E	S	C	ASIL
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph) with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; the vehicle brakes.	The vehicle runs into another vehicle or barrier.	E3	S3	C3	C
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver with braking.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. The vehicle brakes.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver with braking	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends. The vehicle brakes.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Unintended Vehicle Deceleration)			
			E	S	C	ASIL
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver with braking	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the vehicle brakes.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver with braking.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. The vehicle brakes.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver with braking.	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Unintended Vehicle Deceleration)			
			E	S	C	ASIL
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends. The vehicle brakes.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver with braking.	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Table G-5: Loss of Vehicle Longitudinal Motion Control

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Loss of Vehicle Longitudinal Motion Control)			
			E	S	C	ASIL
The driver is supposed to brake and does not, or is not supposed to brake and does resulting in a hazard of loss of control.	Vehicle in a parking lot or drive way and starting to move; good road conditions; pedestrians present.	Hits a pedestrian	E4	S2	C1	A
	Vehicle in a parking lot or drive and starts moving; wet or snowy road; pedestrians present.	The vehicle wheel spins. No substantial vehicle movement from its place.	E4	S2	C1	A
	Vehicle in a parking lot or drive and starts moving; wet or snowy road; pedestrians present.	The vehicle runs into a pedestrian at low speed.	E2	S2	C2	QM
	Vehicle in a parking lot or drive and starts moving; split Mu road; pedestrians present.	The vehicle wheel spins. No substantial vehicle movement from its place.	E2	S2	C2	QM
	Vehicle going in reverse from a stopped condition at (relatively) low speed; other vehicles present (stopped or moving at low speed); slippery/good road conditions; pedestrians present;	The vehicle runs into a pedestrian at low speed.	E2	S2	C2	QM
	Driving inside the city with light/heavy traffic; pedestrians present; stop and go driving, good road conditions.	The vehicle runs into a vehicle or pedestrian at low speed.	E2	S2	C2	QM
	Driving inside the city with light/heavy traffic; pedestrians present, stop and go driving, good road conditions;	The vehicle runs into a vehicle or pedestrian at low speed.	E2	S2	C2	QM
	Driving inside the city with light/heavy traffic; pedestrians present, stop and go driving, wet or snowy road conditions;	The vehicle runs into a vehicle or pedestrian at low speed.	E2	S2	C2	QM
	Driving inside the city with light/heavy traffic; pedestrians present, stop and go driving, wet or snowy road conditions; vehicle in evasive maneuver.	The vehicle runs into a vehicle or pedestrian at low speed.	E2	S2	C2	QM

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Loss of Vehicle Longitudinal Motion Control)			
			E	S	C	ASIL
	Driving inside the city with light/ heavy traffic; pedestrians present, stop and go driving, split Mu road conditions.	The vehicle runs into a vehicle or pedestrian at low speed.	E4	S3	C1	B
	Driving inside the city with light/ heavy traffic; pedestrians present, stop and go driving, split Mu road conditions; vehicle in evasive maneuver.	The vehicle runs into a vehicle or pedestrian at low speed.	E2	S3	C2	A
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends;	The vehicle runs into another vehicle or barrier.	E1	S3	C2	QM
	Driving inside the city (< 40 kph) with heavy traffic and heavy pedestrians present; good road conditions. Moderate road bends.	The vehicle runs into a pedestrian or another vehicle or barrier.	E2	S3	C2	A
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present; good road conditions. Moderate road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E1	S3	C2	QM
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, wet or snowy road conditions; moderate road bends.	The vehicle runs into another vehicle or barrier.	E4	S1	C2	A
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E4	S3	C2	C
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, split Mu road conditions; moderate road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Loss of Vehicle Longitudinal Motion Control)			
			E	S	C	ASIL
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present; good road conditions. Sharp road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present; good road conditions. Sharp road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, wet or snowy road conditions; Sharp road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, wet or snowy road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, split Mu road conditions. Sharp road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Loss of Vehicle Longitudinal Motion Control)			
			E	S	C	ASIL
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, split MU road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends;	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E1	S3	C2	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; the driver steers sharply.	The vehicle runs into another vehicle or barrier.	E1	S3	C2	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. The driver steers sharply.	The vehicle runs into another vehicle or barrier.	E1	S3	C2	QM

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Loss of Vehicle Longitudinal Motion Control)			
			E	S	C	ASIL
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends.	The vehicle runs into another vehicle or barrier.	E4	S3	C3	D
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate bends; The driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Loss of Vehicle Longitudinal Motion Control)			
			E	S	C	ASIL
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. Sharp road bends. The driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. The driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends;	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E1	S3	C2	QM
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Loss of Vehicle Longitudinal Motion Control)			
			E	S	C	ASIL
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A
	Driving at high speed (100 kph < V < 130 kph) with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E4	S3	C3	D
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Loss of Vehicle Longitudinal Motion Control)			
			E	S	C	ASIL
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph) with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Loss of Vehicle Longitudinal Motion Control)			
			E	S	C	ASIL
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends.	The vehicle runs into another vehicle or barrier.	E3	S3	C3	C
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the vehicle.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Loss of Vehicle Longitudinal Motion Control)			
			E	S	C	ASIL
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Table G-6: Insufficient Vehicle Deceleration

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Deceleration)			
			E	S	C	ASIL
Excessive control that ultimately results in Insufficient braking pressure (magnitude or duration) will prevent lockup, but it will result in lower, possibly insufficient deceleration)	Vehicle in a parking lot or drive way and starting to move; good road conditions; pedestrians present. Driver brakes.	Hits a pedestrian	E	S	C	ASIL
	Vehicle in a parking lot or drive way and starts moving; good road conditions; pedestrian presence; driver brakes hard.	The vehicle runs into a pedestrian at low speed.	E4	S2	C1	A
	Vehicle in a parking lot or drive and starts moving; wet or snowy road; pedestrians present.	The vehicle wheel spins. No substantial vehicle movement from its place.	E4	S2	C1	A
	Vehicle in a parking lot or drive and starts moving; wet or snowy road; pedestrians present. Driver brakes.	The vehicle runs into a pedestrian at low speed.	E2	S2	C2	QM
	Vehicle in a parking lot or drive way and starts moving; wet or snowy road; pedestrians present; the driver brakes hard.	The vehicle runs into a pedestrian at low speed.	E2	S2	C2	QM
	Vehicle in a parking lot or drive and starts moving; split Mu road; pedestrians present.	The vehicle wheel spins. No substantial vehicle movement from its place.	E2	S2	C2	QM
	Vehicle in a parking lot or drive way and starting to move; split Mu road; pedestrians present. Driver brakes.	The vehicle runs into a pedestrian at low speed.	E2	S2	C2	QM
	Vehicle in a parking lot or drive way and starts moving; split Mu road; pedestrians present; driver brakes hard.	The vehicle runs into a pedestrian at low speed.	E2	S2	C2	QM

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Deceleration)			
			E	S	C	ASIL
	Vehicle going in reverse from a stopped condition at (relatively) low speed; other vehicles present (stopped or moving at low speed); slippery/good road conditions; pedestrians present; the vehicle brakes hard.	The vehicle runs into a pedestrian at low speed.	E2	S2	C2	QM
	Driving inside the city with light/heavy traffic; pedestrians present, stop and go driving, good road conditions; the driver brakes hard.	The vehicle runs into a vehicle or pedestrian at low speed.	E2	S2	C2	QM
	Driving inside the city with light/heavy traffic; pedestrians present, stop and go driving, wet or snowy road conditions; the vehicle brakes hard.	The vehicle runs into a vehicle or pedestrian at low speed.	E4	S3	C1	B
	Driving inside the city with light/heavy traffic; pedestrians present, stop and go driving, wet or snowy road conditions; vehicle in evasive maneuver with hard braking.	The vehicle runs into a vehicle or pedestrian at low speed.	E2	S3	C2	A
	Driving inside the city with light/ heavy traffic; pedestrians present, stop and go driving, split Mu road conditions. The diver vehicle brakes	The vehicle runs into a vehicle or pedestrian at low speed.	E1	S3	C2	QM
	Driving inside the city with light/ heavy traffic; pedestrians present, stop and go driving, split Mu road conditions; the driver brakes hard.	The vehicle runs into a vehicle or pedestrian at low speed.	E2	S3	C2	A
	Driving inside the city with light/ heavy traffic; pedestrians present, stop and go driving, split Mu road conditions; vehicle in evasive maneuver with hard braking.	The vehicle runs into a vehicle or pedestrian at low speed.	E2	S3	C2	A
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; the vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E1	S3	C2	QM
	Driving inside the city (< 40 kph) with heavy traffic and heavy pedestrians present; good road conditions. Moderate road bends; the vehicle brakes hard.	The vehicle runs into a pedestrian or another vehicle or barrier.	E4	S1	C2	A

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Deceleration)			
			E	S	C	ASIL
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver with hard braking.	The vehicle runs into another vehicle or barrier.	E4	S3	C2	C
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present; good road conditions. Moderate road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, wet or snowy road conditions; moderate road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, wet or snowy road conditions; moderate road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, split Mu road conditions; moderate road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, split MU road conditions; moderate road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Deceleration)			
			E	S	C	ASIL
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present; good road conditions. Sharp road bends; the vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver with hard braking.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present; good road conditions. Sharp road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, wet or snowy road conditions; Sharp road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, wet or snowy road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E1	S3	C2	QM
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, split Mu road conditions. Sharp road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E1	S3	C2	QM
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Deceleration)			
			E	S	C	ASIL
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, split MU road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; the driver brakes hard.	The vehicle runs into another vehicle or barrier.	E1	S3	C2	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver with hard braking.	The vehicle runs into another vehicle or barrier.	E4	S3	C3	D
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; the driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. The driver brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. The driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Deceleration)			
			E	S	C	ASIL
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate bends; The driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the driver brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver with hard braking.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. The driver brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Deceleration)			
			E	S	C	ASIL
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. Sharp road bends. The driver steers sharply.	The vehicle runs into another vehicle or barrier.	E1	S3	C2	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. The driver steers sharply.	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; driver brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E4	S3	C3	D
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Deceleration)			
			E	S	C	ASIL
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph) with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver with hard braking.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Deceleration)			
			E	S	C	ASIL
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A
	Driving at very high speed (V > 130 kph) with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; the vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver with hard braking.	The vehicle runs into another vehicle or barrier.	E3	S3	C3	C

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Deceleration)			
			E	S	C	ASIL
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Deceleration)			
			E	S	C	ASIL
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver with hard braking.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends. The vehicle brakes hard.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A

Table G-7: Unintended Vehicle Propulsion

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Unintended Vehicle Propulsion)			
			E	S	C	ASIL
ECS requests a propulsion increase to mitigate wheel lock - there is no limit on the amount of propulsion ESC can request	Vehicle in a parking lot or drive way and starting to move; good road conditions; pedestrians present.	Hits a pedestrian	E4	S2	C0	
	Vehicle in a parking lot or drive and starts moving; wet or snowy road; pedestrians present.	The vehicle runs into a pedestrian at low speed.	E2	S2	C0	
	Vehicle in a parking lot or drive way and starting to move; split Mu road; pedestrians present.	The vehicle runs into a pedestrian at low speed.	E2	S2	C0	
	Vehicle going in reverse from a stopped condition at (relatively) low speed; other vehicles present (stopped or moving at low speed); slippery/good road conditions; pedestrians present;	The vehicle runs into a pedestrian at low speed.	E2	S2	C1	QM
	Driving inside the city with light/heavy traffic; pedestrians present; stop and go driving, good road conditions.	The vehicle runs into a vehicle or pedestrian at low speed.	E4	S3	C1	B
	Driving inside the city with light/heavy traffic; pedestrians present, stop and go driving, wet or snowy road conditions;	The vehicle runs into a vehicle or pedestrian at low speed.	E2	S3	C1	QM
	Driving inside the city with light/heavy traffic; pedestrians present, stop and go driving, wet or snowy road conditions; vehicle in evasive maneuver.	The vehicle runs into a vehicle or pedestrian at low speed.	E1	S3	C1	QM
	Driving inside the city with light/ heavy traffic; pedestrians present, stop and go driving, split Mu road conditions.	The vehicle runs into a vehicle or pedestrian at low speed.	E2	S3	C1	QM
	Driving inside the city with light/ heavy traffic; pedestrians present, stop and go driving, split Mu road conditions; vehicle in evasive maneuver.	The vehicle runs into a vehicle or pedestrian at low speed.	E2	S3	C1	QM

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Unintended Vehicle Propulsion)			
			E	S	C	ASIL
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends;	The vehicle runs into another vehicle or barrier.	E4	S1	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present; good road conditions. Moderate road bends.	The vehicle runs into a pedestrian or another vehicle or barrier.	E4	S3	C1	B
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present; good road conditions. Moderate road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, wet or snowy road conditions; moderate road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, split Mu road conditions; moderate road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Unintended Vehicle Propulsion)			
			E	S	C	ASIL
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present; good road conditions. Sharp road bends;	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present; good road conditions. Sharp road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, wet or snowy road conditions; Sharp road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver	The vehicle runs into another vehicle or barrier.	E1	S3	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, wet or snowy road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, split Mu road conditions. Sharp road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E1	S3	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and pedestrians present, split MU road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Unintended Vehicle Propulsion)			
			E	S	C	ASIL
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions; Moderate road bends.	The vehicle runs into another vehicle or barrier.	E4	S3	C1	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; the driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. The driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate bends; The driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Unintended Vehicle Propulsion)			
			E	S	C	ASIL
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E1	S3	C2	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. Sharp road bends. The driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E1	S3	C2	QM

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Unintended Vehicle Propulsion)			
			E	S	C	ASIL
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. The driver steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends;	The vehicle runs into another vehicle or barrier.	E4	S3	C2	C
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at high speed (100 kph < V < 130 kph) with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Unintended Vehicle Propulsion)			
			E	S	C	ASIL
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Unintended Vehicle Propulsion)			
			E	S	C	ASIL
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C2	A
	Driving at very high speed (V > 130 kph) with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends.	The vehicle runs into another vehicle or barrier.	E3	S3	C3	C
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Unintended Vehicle Propulsion)			
			E	S	C	ASIL
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the vehicle.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver with hard braking	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Unintended Vehicle Propulsion)			
			E	S	C	ASIL
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver.	The vehicle runs into another vehicle or barrier.	E1	S3	C3	A
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. The vehicle steers sharply.	The vehicle runs into another vehicle or barrier.	E2	S3	C3	B

Table G-8: Insufficient Vehicle Propulsion

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Propulsion)			
			E	S	C	ASIL
TCS does not release the brake pressure following a TCS event.	Vehicle in a parking lot or drive way and starting to move; good road conditions; pedestrians present.	No accident scenario.	E4	S0		
	Vehicle in a parking lot or drive and starts moving; wet or snowy road; pedestrians present.	No accident scenario.	E2	S0		
	Vehicle in a parking lot or drive way and starting to move; split Mu road; pedestrians present.	No accident scenario.	E1	S3	C2	QM
	Vehicle going in reverse from a stopped condition at (relatively) low speed; other vehicles present (stopped or moving at low speed); slippery/good road conditions; pedestrians present.	No accident scenario.	E2	S0		
	Driving inside the city with light/heavy traffic; pedestrians present; stop and go driving, good road conditions.	Risk of rear collision	E4	S1	C0	
	Driving inside the city with light/heavy traffic; pedestrians present, stop and go driving, wet or snowy road conditions.	Risk of rear collision	E2	S1	C0	
	Driving inside the city with light/heavy traffic; pedestrians present, stop and go driving, wet or snowy road conditions; vehicle in evasive maneuver.	Risk of rear collision	E1	S1	C0	
	Driving inside the city with light/ heavy traffic; pedestrians present, stop and go driving, split Mu road conditions.	Risk of rear collision	E2	S1	C0	
	Driving inside the city with light/ heavy traffic; pedestrians present, stop and go driving, split Mu road conditions; vehicle in evasive maneuver.	Risk of rear collision	E1	S1	C0	

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Propulsion)			
			E	S	C	ASIL
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends.	Rear collision with another vehicle	E4	S1	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver.	Rear collision with another vehicle	E2	S1	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends.	Rear collision with another vehicle	E2	S1	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends.	Rear collision with another vehicle	E2	S1	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver.	Rear collision with another vehicle	E2	S1	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. The vehicle steers sharply.	Rear collision with another vehicle	E2	S1	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends.	Rear collision with another vehicle	E2	S1	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver.	Rear collision with another vehicle	E2	S1	C1	QM

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Propulsion)			
			E	S	C	ASIL
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. The vehicle steers sharply.	Rear collision with another vehicle	E2	S1	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends.	Rear collision with another vehicle	E2	S1	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver.	Rear collision with another vehicle	E2	S1	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle steers sharply.	Rear collision with another vehicle	E2	S1	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends.	Rear collision with another vehicle	E2	S1	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver.	Rear collision with another vehicle	E1	S1	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, wet or snowy road conditions. Sharp road bends. The vehicle steers sharply.	Rear collision with another vehicle	E2	S1	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends.	Rear collision with another vehicle	E2	S1	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver.	Rear collision with another vehicle	E1	S1	C1	QM

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Propulsion)			
			E	S	C	ASIL
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. The vehicle steers sharply.	Rear collision with another vehicle	E2	S1	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends.	Collision with another vehicle	E4	S2	C1	A
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver.	collision with another vehicle	E2	S2	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; the driver steers sharply.	collision with another vehicle	E2	S2	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver.	collision with another vehicle	E2	S2	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions, moderate road bends. The driver steers sharply.	collision with another vehicle	E2	S2	C1	QM
	Driving inside the city (< 40 kph) with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends.	collision with another vehicle	E2	S2	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver.	collision with another vehicle	E2	S2	C1	QM

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Propulsion)			
			E	S	C	ASIL
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate bends; The driver steers sharply.	collision with another vehicle	E2	S2	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends.	collision with another vehicle	E2	S2	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver.	collision with another vehicle	E2	S2	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; the driver steers sharply.	collision with another vehicle	E2	S2	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends.	collision with another vehicle	E2	S2	C1	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver.	collision with another vehicle	E1	S2	C2	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. Sharp road bends. The driver steers sharply.	collision with another vehicle	E2	S2	C2	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends.	collision with another vehicle	E2	S2	C1	QM

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Propulsion)			
			E	S	C	ASIL
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver.	collision with another vehicle	E1	S2	C2	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. The driver steers sharply.	collision with another vehicle	E2	S2	C2	QM
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, good road conditions. Overtaking maneuver	Head on collision with incoming traffic	E2	S3	C3	B
	Driving at medium speed (40 kph < V < 100 kph), with heavy traffic and negligible pedestrians present, wet/snow or split MU road conditions. Overtaking maneuver	Head on collision with incoming traffic	E1	S3	C3	A
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends.	Collision with another vehicle	E4	S2	C2	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle steers sharply.	Collision with another vehicle	E2	S2	C2	QM
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends.	Collision with another vehicle	E2	S2	C2	QM
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver.	Collision with another vehicle	E2	S2	C2	QM

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Propulsion)			
			E	S	C	ASIL
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. The vehicle steers sharply.	Collision with another vehicle	E2	S2	C2	QM
	Driving at high speed (100 kph < V < 130 kph) with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends.	Collision with another vehicle	E2	S2	C2	QM
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver.	Collision with another vehicle	E2	S2	C2	QM
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. The vehicle steers sharply.	Collision with another vehicle	E2	S2	C2	QM
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends.	Collision with another vehicle	E2	S2	C2	QM
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver.	Collision with another vehicle	E2	S2	C2	QM
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle steers sharply.	Collision with another vehicle	E2	S2	C2	QM
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends.	Collision with another vehicle	E2	S2	C2	QM

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Propulsion)			
			E	S	C	ASIL
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver.	Collision with another vehicle	E1	S2	C2	QM
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. Sharp road bends. The vehicle steers sharply.	Collision with another vehicle	E2	S2	C2	QM
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends.	Collision with another vehicle	E2	S2	C2	QM
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver.	Collision with another vehicle	E1	S2	C2	QM
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. The vehicle steers sharply.	Collision with another vehicle	E2	S2	C2	QM
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, good road conditions. Sharp road bends. Overtaking maneuver.	Head on collision with incoming traffic	E2	S3	C3	B
	Driving at high speed (100 kph < V < 130 kph), with heavy traffic and negligible pedestrians present, wet/snow or split Mu road conditions. Overtaking maneuver.	Head on collision with incoming traffic	E1	S3	C3	A
	Driving at very high speed (V > 130 kph) with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends.	Collision with another vehicle	E3	S3	C3	C

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Propulsion)			
			E	S	C	ASIL
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle in evasive maneuver.	Collision with another vehicle	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Moderate road bends; vehicle steers sharply.	Collision with another vehicle	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends.	Collision with another vehicle	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. Vehicle in evasive maneuver.	Collision with another vehicle	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; moderate road bends. The vehicle steers sharply.	Collision with another vehicle	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions; moderate road bends.	Collision with another vehicle	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions; moderate road bends. Vehicle in evasive maneuver.	Collision with another vehicle	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. The vehicle steers sharply.	Collision with another vehicle	E2	S3	C3	B

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Propulsion)			
			E	S	C	ASIL
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends.	Collision with another vehicle	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle in evasive maneuver.	Collision with another vehicle	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present; good road conditions. Sharp road bends; vehicle steers sharply.	Collision with another vehicle	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver with braking.	Collision with another vehicle	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions; Sharp road bends. Vehicle in evasive maneuver.	Collision with another vehicle	E1	S3	C3	A
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet or snowy road conditions. Sharp road bends. The vehicle steers sharply.	Collision with another vehicle	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split Mu road conditions. Sharp road bends.	Collision with another vehicle	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. Vehicle in evasive maneuver.	Collision with another vehicle	E1	S3	C3	A

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment (Insufficient Vehicle Propulsion)			
			E	S	C	ASIL
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, split MU road conditions. Sharp road bends. The vehicle steers sharply.	Collision with another vehicle	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, good road conditions. Overtaking maneuver	Head on collision with incoming traffic	E2	S3	C3	B
	Driving at very high speed (V > 130 kph), with heavy traffic and negligible pedestrians present, wet/snow or split MU road conditions. Overtaking maneuver	Head on collision with incoming traffic	E1	S3	C3	A

Table G-9: Insufficient Vehicle Propulsion

Assumptions	Operating Scenario Description	Potential Accident Scenario	ASIL Assessment			
			E	S	C	ASIL
Hill Hold control	Vehicle Parked	N/A				
	Vehicle in traffic, on an incline, facing downward; pedestrian presence,	Rolls forward into a vehicle or pedestrian	E3	S2	C1	QM
	Vehicle in traffic, on an incline, facing downward; negligible pedestrian presence.	Rolls forward into a vehicle	E3	S1	C1	QM
	Vehicle in traffic, on an incline, facing upward; pedestrian presence.	Rolls backward into a vehicle or pedestrian	E3	S2	C2	QM
	Vehicle in traffic, on an incline, facing upward; negligible pedestrian presence.	Rolls backward into a vehicle	E3	S1	C2	QM
	Vehicle stopped in traffic on high incline with unsecured steep slop	Vehicle rolls off the cliff	E1	S3	C2	QM

APPENDIX H: FMEA

Table H-1. FMEA for H1: Unintended Vehicle Lateral Motion/Unintended Yaw

System/Subsystem	Failure Mode	Cause of Failure
Brake/Stability Control Module (including ESC, ABS, and Traction Control)	Commands brake modulator to provide too much brake pressure to rear wheels causing wheel lock-up	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in control module I/Os connections
		Short in control module I/Os connections to ground or voltage
		Short in control module I/Os connections to another connection
		Signal connector connection failure
		Power connector connection failure
		Arbitration logic fault
		Firmware crash/failure (SW parameters corrupted)
		Supply power out of range
		Supply power quality failure
		EMI/EMC fault
		Contamination/Corrosion
		NVH fault
		Environmental temperature exposure failure
		Aging (durability)
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance
	Commands brake modulator to provide too much brake pressure to one side of the vehicle (left/right proportioning)	HW or SW Fault (covered above)
	Commands differential braking force from brake modulator when not needed for yaw stability	HW or SW Fault (covered above)
	Improperly calculates current deceleration rate - brake controller believes more braking force is available in the rear than actually exists	HW or SW Fault (covered above)

System/Subsystem	Failure Mode	Cause of Failure
	Improperly calculates vehicle yaw rate	HW or SW Fault (covered above)
	Improperly calculates road friction coefficient	HW or SW Fault (covered above)
	Improperly calculates front/rear static or dynamic load distribution	HW or SW Fault (covered above)
	Miscommunicates with internal subsystems	From: Yaw Rate Sensor
		From: Lateral Acceleration Sensor
		From: Longitudinal Acceleration Sensor
		From: Wheel Speed Sensors
		From: Brake Pressure Sensor
		From: Disable Stability Control Button
		To: Brake Modulator
	Miscommunicates steering wheel position	From: Steering System
	Miscommunicates differential braking request	From: Other Vehicle Systems (e.g. ALC/LKA, AEB, ACC)
	Miscommunicates with external systems	To: Steering System
		To: Active Differential System
		To: Accelerator Control System (ACS/ETC) and Engine
		From: Electronic Parking Brake System
	Diagnostic fault	Considered only in mitigation of multiple point failure analysis (FTA)
Brake Modulator	Transmits too much pressure to rear wheels	Internal connection fault (short or open)
		Signal connector connection failure
		Power connector connection failure
		Supply power out of range
		Supply power quality failure
		HW fault in metering valve (if present)
		HW fault in proportioning valve (if present)
		HW fault in insulation and windings
		HW fault within hydraulic system (e.g. leak, clog)
		Over or under current
		Manufacturing variability

System/Subsystem	Failure Mode	Cause of Failure
		Manufacturing defect
	Transmits incorrect brake pressure during yaw stabilization event	HW fault (covered above)
	Pulses only front wheels and rear wheels are allowed to lock	HW fault (covered above)
	Pulses rear wheels and no brake pressure is applied to front wheels	HW fault (covered above)
	Pressure is delayed to front wheels and rear wheels are allowed to lock	HW fault (covered above)
	Hydraulic clog or leak between modulator and front brakes	HW fault (covered above)
	Electromagnetic interference with other brake system components	Over-emission of EMF
		Inadequate shielding
	Mechanical failure	Out of scope
Disable Stability Control Button	None known that results in this specific malfunction	
Brake Booster	None known that results in this specific malfunction	
Master Cylinder / Hydraulic Reservoir	None known that results in this specific malfunction	
Brake Pedal Assembly	None known that results in this specific malfunction	
Brake Pads / Drums Assembly	Mechanical failure	Out of scope
Roll Rate Sensor	None known that results in this specific malfunction	
Yaw Rate Sensor	Measured yaw rate (deg/sec) value is higher than the actual yaw rate.	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in sensor I/Os connections
		Short in sensor I/Os connections to ground or voltage
		Short in I/Os connections to another connection
		Signal connector connection failure
		Power connector connection failure

System/Subsystem	Failure Mode	Cause of Failure
		Sensor output calculation algorithm fault
		SW parameters corrupted
		Supply power out of range
		Supply power quality failure
		EMC/EMI fault
		Contamination/Corrosion
		NVH fault
		Environmental temperature exposure failure
		Aging (durability)
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance
	Measured yaw rate (deg/sec) value is lower than the actual yaw rate.	HW or SW fault (covered above)
	Measured yaw rate (deg/sec) value is in opposite direction of actual yaw rate.	HW or SW fault (covered above)
	Yaw rate sensor communicates with Brake/Stability control module incorrectly	HW or SW fault (covered above)
		Communication bus fault
Lateral Acceleration Sensor	Measured lateral acceleration (g to the left or right) value is higher than actual lateral acceleration.	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in sensor I/Os connections
		Short in sensor I/Os connections to ground or voltage
		Short in I/Os connections to another connection
		Signal connector connection failure
		Power connector connection failure
		Sensor output calculation algorithm fault
		SW parameters corrupted
		Supply power out of range
		Supply power quality failure

System/Subsystem	Failure Mode	Cause of Failure
		EMC/EMI fault
		Contamination/Corrosion
		NVH fault
		Environmental temperature exposure failure
		Aging (durability)
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance
	Measured lateral acceleration (g to the left or right) value is lower than actual lateral acceleration.	HW or SW fault (covered above)
	Lateral Acceleration sensor communicates with Brake/Stability control module incorrectly	HW or SW fault (covered above)
		Communication bus fault
Longitudinal Acceleration Sensor	Measured longitudinal acceleration (g forward or rearward) value is higher than actual longitudinal acceleration.	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in sensor I/Os connections
		Short in sensor I/Os connections to ground or voltage
		Short in I/Os connections to another connection
		Signal connector connection failure
		Power connector connection failure
		Sensor output calculation algorithm fault
		SW parameters corrupted
		Supply power out of range
		Supply power quality failure
		EMC/EMI fault
		Contamination/Corrosion
		NVH fault
		Environmental temperature exposure failure
		Aging (durability)

System/Subsystem	Failure Mode	Cause of Failure
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance
	Longitudinal Acceleration sensor communicates with Brake/Stability control module incorrectly	HW or SW fault (covered above)
		Communication bus fault
Wheel Speed Sensors	Measured rear wheel speed value is higher than actual wheel speed.	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in sensor I/Os connections
		Short in sensor I/Os connections to ground or voltage
		Short in I/Os connections to another connection
		Signal connector connection failure
		Power connector connection failure
		Sensor output calculation algorithm fault
		SW parameters corrupted
		Supply power out of range
		Supply power quality failure
		EMC/EMI fault
		Contamination/Corrosion
		NVH fault
		Environmental temperature exposure failure
		Aging (durability)
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance
	Measured front wheel speed value is lower than actual front wheel speed (rear wheel speed is correctly measured).	HW or SW fault (covered above)
	Wheel Speed sensors communicate with Brake/Stability control module incorrectly	HW or SW fault (covered above)

System/Subsystem	Failure Mode	Cause of Failure
		Communication bus fault
Brake Pedal Position Sensor	None known that results in this specific malfunction	
Brake Pressure Sensor	None known that results in this specific malfunction	
Steering System	Does not provide requested steering	Communication Fault with CHB System
	Does not coordinate yaw rate stabilization activities with CHB system	Communication Fault with CHB System
	Other system faults	Out of scope
Active Differential System	Does not coordinate yaw rate stabilization activities with CHB system	Communication Fault with CHB System
	Other system faults	Out of scope
ACS/ETC	Does not provide requested torque adjustment	Communication Fault with CHB System
	Other system faults	Out of scope
Electronic Parking Brake	Does not coordinate brake activation for rear wheels	Communication Fault with CHB System
	Other system faults	Out of scope
Other Vehicle Systems	Request for braking is incorrect when received by CHB system	Communication Fault with CHB System
	Other system faults	Out of scope

Table H-2. FMEA for H2: Insufficient Vehicle Lateral Motion/Insufficient Yaw

System/Subsystem	Failure Mode	Cause of Failure
Brake/Stability Control Module (including ESC, ABS, and Traction Control)	Commands brake modulator to provide too little brake pressure to spinning wheel	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in control module I/Os connections
		Short in control module I/Os connections to ground or voltage
		Short in control module I/Os connections to another connection
		Signal connector connection failure
		Power connector connection failure
		Arbitration logic fault
		Firmware crash/failure (SW parameters corrupted)
		Supply power out of range
		Supply power quality failure
		EMI/EMC fault
		Contamination/Corrosion
		NVH fault

System/Subsystem	Failure Mode	Cause of Failure
		Environmental temperature exposure failure
		Aging (durability)
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance
	Commands brake modulator to provide too little brake pressure to wheels for yaw stabilization/differential braking	HW or SW Fault (covered above)
	Improperly calculates vehicle yaw rate	HW or SW Fault (covered above)
	Improperly calculates road friction coefficient	HW or SW Fault (covered above)
	Improperly calculates load on propulsion wheels.	HW or SW Fault (covered above)
	Miscommunicates with internal subsystems	From: Roll Rate Sensor
		From: Yaw Rate Sensor
		From: Lateral Acceleration Sensor
		From: Longitudinal Acceleration Sensor
		From: Wheel Speed Sensors
		From: Brake Pressure Sensor
		From: Disable Stability Control Button

System/Subsystem	Failure Mode	Cause of Failure
		To: Brake Modulator
	Miscommunicates steering wheel position	From: Steering System
	Miscommunicates differential braking request	From: Other Vehicle Systems (e.g. ALC/LKA, AEB, ACC)
	Miscommunicates with external systems	To: Steering System
		To: Active Differential System
		To: Accelerator Control System (ACS/ETC) and Engine
		From: Electronic Parking Brake System
	Diagnostic fault	Considered only in mitigation of multiple point failure analysis (FTA)
Brake Modulator	Transmits too little brake pressure to spinning wheel	Internal connection fault (short or open)
		Signal connector connection failure
		Power connector connection failure
		Supply power out of range
		Supply power quality failure
		HW fault in metering valve (if present)
		HW fault in proportioning valve (if present)

System/Subsystem	Failure Mode	Cause of Failure
		HW fault in insulation and windings
		HW fault within hydraulic system (e.g. leak, clog)
		Over or under current
		Manufacturing variability
		Manufacturing defect
	Transmits incorrect brake pressure during yaw stabilization event	HW fault (covered above)
	Transmits too much brake pressure to non-spinning wheel	HW fault (covered above)
	Transmits equal brake pressure to driven wheels despite asymmetric traction	HW fault (covered above)
	Transmission of brake pressure to spinning wheel is delayed	HW fault (covered above)
	Electromagnetic interference with other Brake system components	Over-emission of EMF
		Inadequate shielding
	Mechanical failure	Out of scope
Disable Stability Control Button	Switch fails to Stability Control off position (i.e., no traction control)	HW fault (standard causes of switch failures)
Brake Booster	None known that results in this specific malfunction	

System/Subsystem	Failure Mode	Cause of Failure
Master Cylinder / Hydraulic Reservoir	None known that results in this specific malfunction	
Brake Pedal Assembly	None known that results in this specific malfunction	
Brake Pads / Drums Assembly	Mechanical failure	Out of scope
Yaw Rate Sensor	Measured yaw rate (deg/sec) value is lower than the actual yaw rate. Results in an incorrect calculation of available brake force at each wheel, and too much pressure is transmitted to a rear wheel	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in sensor I/Os connections
		Short in sensor I/Os connections to ground or voltage
		Short in I/Os connections to another connection
		Signal connector connection failure
		Power connector connection failure
		Sensor output calculation algorithm fault
		SW parameters corrupted
		Supply power out of range
		Supply power quality failure

System/Subsystem	Failure Mode	Cause of Failure
		EMC/EMI fault
		Contamination/Corrosion
		NVH fault
		Environmental temperature exposure failure
		Aging (durability)
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance
	Yaw rate sensor communicates with Brake/Stability control module incorrectly	HW or SW fault (covered above)
		Communication bus fault
Roll Rate Sensor	Measured roll rate (deg/sec) value is lower than actual roll rate.	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in sensor I/Os connections
		Short in sensor I/Os connections to ground or voltage
		Short in I/Os connections to another connection

System/Subsystem	Failure Mode	Cause of Failure
		Signal connector connection failure
		Power connector connection failure
		Sensor output calculation algorithm fault
		SW parameters corrupted
		Supply power out of range
		Supply power quality failure
		EMC/EMI fault
		Contamination/Corrosion
		NVH fault
		Environmental temperature exposure failure
		Aging (durability)
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance
	Measured roll rate (deg/sec) value is higher than actual roll rate.	HW or SW fault (covered above)

System/Subsystem	Failure Mode	Cause of Failure
	Roll rate sensor communicates with Brake/Stability control module incorrectly	HW or SW fault (covered above)
		Communication bus fault
Lateral Acceleration Sensor	Measured lateral acceleration (g to the left or right) value is higher than actual lateral acceleration.	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in sensor I/Os connections
		Short in sensor I/Os connections to ground or voltage
		Short in I/Os connections to another connection
		Signal connector connection failure
		Power connector connection failure
		Sensor output calculation algorithm fault
		SW parameters corrupted
		Supply power out of range
		Supply power quality failure
		EMC/EMI fault
		Contamination/Corrosion

System/Subsystem	Failure Mode	Cause of Failure
		NVH fault
		Environmental temperature exposure failure
		Aging (durability)
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance
	Measured lateral acceleration (g to the left or right) value is lower than actual lateral acceleration.	HW or SW fault (covered above)
	Lateral Acceleration sensor communicates with Brake/Stability control module incorrectly	HW or SW fault (covered above)
		Communication bus fault
Longitudinal Acceleration Sensor	Measured longitudinal acceleration (g forward or rearward) value is higher than actual longitudinal acceleration.	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in sensor I/Os connections
		Short in sensor I/Os connections to ground or voltage
		Short in I/Os connections to another connection
		Signal connector connection failure

System/Subsystem	Failure Mode	Cause of Failure
		Power connector connection failure
		Sensor output calculation algorithm fault
		SW parameters corrupted
		Supply power out of range
		Supply power quality failure
		EMC/EMI fault
		Contamination/Corrosion
		NVH fault
		Environmental temperature exposure failure
		Aging (durability)
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance
	Measured longitudinal acceleration (g forward or rearward) value is lower than actual longitudinal acceleration.	HW or SW fault (covered above)
	Longitudinal Acceleration sensor communicates with Brake/Stability control module incorrectly	HW or SW fault (covered above)

System/Subsystem	Failure Mode	Cause of Failure
		Communication bus fault
Wheel Speed Sensors	Measured wheel speed of spinning wheel is lower than actual wheel speed.	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in sensor I/Os connections
		Short in sensor I/Os connections to ground or voltage
		Short in I/Os connections to another connection
		Signal connector connection failure
		Power connector connection failure
		Sensor output calculation algorithm fault
		SW parameters corrupted
		Supply power out of range
		Supply power quality failure
		EMC/EMI fault
		Contamination/Corrosion
		NVH fault
		Environmental temperature exposure failure

System/Subsystem	Failure Mode	Cause of Failure
		Aging (durability)
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance
	Measured wheel speed is higher than actual wheel speed.	HW or SW fault (covered above)
		HW or SW fault (covered above)
	Wheel Speed sensors communicate with Brake/Stability control module incorrectly	HW or SW fault (covered above)
		Communication bus fault
Brake Pedal Position Sensor	None known that results in this specific malfunction	
Brake Pressure Sensor	None known that results in this specific malfunction	
Steering System	Does not provide requested steering	Communication Fault with CHB System
	Does not coordinate yaw rate stabilization activities with CHB system	Communication Fault with CHB System
	Other system faults	Out of scope
Active Differential System	Does not coordinate yaw rate stabilization activities with CHB system	Communication Fault with CHB System

System/Subsystem	Failure Mode	Cause of Failure
	Other system faults	Out of scope
ACS/ETC	Does not provide requested torque adjustment	Communication Fault with CHB System
	Other system faults	Out of scope
Electronic Parking Brake	Does not coordinate brake activation for rear wheels	Communication Fault with CHB System
	Other system faults	Out of scope
Other Vehicle Systems	Request for braking is incorrect when received by CHB system	Communication Fault with CHB System
	Other system faults	Out of scope

Table H-3. FMEA for H3: Loss of Lateral Motion Control

System/Subsystem	Failure Mode	Cause of Failure
Brake/Stability Control Module (including ESC, ABS, and Traction Control)	Commands brake modulator to provide too much brake pressure to brakes on side with less weight or less friction	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in control module I/Os connections
		Short in control module I/Os connections to ground or voltage
		Short in control module I/Os connections to another connection
		Signal connector connection failure
		Power connector connection failure
		Arbitration logic fault
		Firmware crash/failure (SW parameters corrupted)
		Supply power out of range
		Supply power quality failure
		EMI/EMC fault
		Contamination/Corrosion
		NVH fault

System/Subsystem	Failure Mode	Cause of Failure
		Environmental temperature exposure failure
		Aging (durability)
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance
	Improperly calculates load on each side of vehicle	HW or SW Fault (covered above)
	Fails to activate ABS function during imminent wheel lockup	HW or SW Fault (covered above)
	Improperly calculates road friction coefficient, including incorrect determination of a split-mu surface	HW or SW Fault (covered above)
	Miscommunicates with internal subsystems	From: Roll Rate Sensor
		From: Lateral Acceleration Sensor
		From: Wheel Speed Sensors
		From: Brake Pedal Position Sensor
		From: Brake Pressure Sensor
		To: Brake Modulator
	Miscommunicates steering wheel position	From: Steering System

System/Subsystem	Failure Mode	Cause of Failure
	Miscommunicates differential braking request	From: Other Vehicle Systems (e.g. ALC/LKA, AEB, ACC)
	Miscommunicates with external systems	To: Steering System
		To: Active Differential System
		To: Accelerator Control System (ACS/ETC) and Engine
	Diagnostic fault	Considered only in mitigation of multiple point failure analysis (FTA)
Brake Modulator	Transmits too much pressure to wheels on side of vehicle with less load/friction	Internal connection fault (short or open)
		Signal connector connection failure
		Power connector connection failure
		Supply power out of range
		Supply power quality failure
		HW fault in metering valve (if present)
		HW fault in proportioning valve (if present)
		HW fault within hydraulic system (e.g. leak, clog)
		HW fault in insulation and windings
		Over or under current

System/Subsystem	Failure Mode	Cause of Failure
		Manufacturing variability
		Manufacturing defect
	Pulses brake pressure symmetrically on both left and right sides during ABS, despite load imbalance	HW fault (covered above)
	Electromagnetic interference with other Brake system components	Over-emission of EMF
		Inadequate shielding
	Mechanical failure	Out of scope
Disable Stability Control Button	None known that results in this specific malfunction	
Brake Booster	None known that results in this specific malfunction	
Master Cylinder / Hydraulic Reservoir	None known that results in this specific malfunction	
Brake Pedal Assembly	None known that results in this specific malfunction	
Brake Pads / Drums Assembly	Mechanical failure	Out of scope
Yaw Rate Sensor	None known that results in this specific malfunction	
Roll Rate Sensor	Measured roll rate (deg/sec) value is higher than actual roll rate.	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)

System/Subsystem	Failure Mode	Cause of Failure
		Internal connection fault (short or open)
		Break in sensor I/Os connections
		Short in sensor I/Os connections to ground or voltage
		Short in I/Os connections to another connection
		Signal connector connection failure
		Power connector connection failure
		Sensor output calculation algorithm fault
		SW parameters corrupted
		Supply power out of range
		Supply power quality failure
		EMC/EMI fault
		Contamination/Corrosion
		NVH fault
		Environmental temperature exposure failure
		Aging (durability)
		Manufacturing defect

System/Subsystem	Failure Mode	Cause of Failure
		Manufacturing variability
		Service/Maintenance
	Measured roll rate (deg/sec) value is lower than actual roll rate.	HW or SW fault (covered above)
	Roll rate sensor communicates with Brake/Stability control module incorrectly	HW or SW fault (covered above)
		Communication bus fault
Lateral Acceleration Sensor	Measured lateral acceleration (g to the left or right) value is higher than actual lateral acceleration.	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in sensor I/Os connections
		Short in sensor I/Os connections to ground or voltage
		Short in I/Os connections to another connection
		Signal connector connection failure
		Power connector connection failure
		Sensor output calculation algorithm fault
		SW parameters corrupted
		Supply power out of range

System/Subsystem	Failure Mode	Cause of Failure
		Supply power quality failure
		EMC/EMI fault
		Contamination/Corrosion
		NVH fault
		Environmental temperature exposure failure
		Aging (durability)
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance
	Measured lateral acceleration (g to the left or right) value is lower than actual lateral acceleration.	HW or SW fault (covered above)
	Lateral Acceleration sensor communicates with Brake/Stability control module incorrectly	HW or SW fault (covered above)
		Communication bus fault
Longitudinal Acceleration Sensor	None known that results in this specific malfunction	
Wheel Speed Sensors	Measured wheel speed of spinning wheel is lower than actual wheel speed.	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)

System/Subsystem	Failure Mode	Cause of Failure
		Internal connection fault (short or open)
		Break in sensor I/Os connections
		Short in sensor I/Os connections to ground or voltage
		Short in I/Os connections to another connection
		Signal connector connection failure
		Power connector connection failure
		Sensor output calculation algorithm fault
		SW parameters corrupted
		Supply power out of range
		Supply power quality failure
		EMC/EMI fault
		Contamination/Corrosion
		NVH fault
		Environmental temperature exposure failure
		Aging (durability)
		Manufacturing defect

System/Subsystem	Failure Mode	Cause of Failure
		Manufacturing variability
		Service/Maintenance
	Wheel Speed sensors communicate with Brake/Stability control module incorrectly	HW or SW fault (covered above)
		Communication bus fault
Brake Pedal Position Sensor	None known that results in this specific malfunction	
Brake Pressure Sensor	None known that results in this specific malfunction	

Table H-4. FMEA for H4: Unintended Vehicle Deceleration

System/Subsystem	Failure Mode	Cause of Failure
Brake/Stability Control Module (including ESC, ABS, and Traction Control)	Commands brake modulator to provide too much brake pressure to wheels	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in control module I/Os connections
		Short in control module I/Os connections to ground or voltage
		Short in control module I/Os connections to another connection
		Signal connector connection failure
		Power connector connection failure
		Arbitration logic fault
		Firmware crash/failure (SW parameters corrupted)
		Supply power out of range
		Supply power quality failure
		EMI/EMC fault
		Contamination/Corrosion
		NVH fault

System/Subsystem	Failure Mode	Cause of Failure
		Environmental temperature exposure failure
		Aging (durability)
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance
	Incorrectly computes brake force needed for internal brake function	HW or SW Fault (covered above)
	Improperly calculates current deceleration rate. Brake controller believes the vehicle is decelerating less than the actual deceleration.	HW or SW Fault (covered above)
	Miscommunicates with internal subsystems	From: Longitudinal Acceleration Sensor
		From: Wheel Speed Sensors
		From: Brake Pedal Position Sensor
		From: Brake Pressure Sensor
		To: Brake Modulator
	Miscommunicates braking request	From: Other Vehicle Systems (e.g. ALC/LKA, AEB, ACC)
	Miscommunicates with external systems	From: Transmission System

System/Subsystem	Failure Mode	Cause of Failure
	Diagnostic fault	Considered only in mitigation of multiple point failure analysis (FTA)
Brake Modulator	Transmits too much brake pressure to wheels	Internal connection fault (short or open)
		Signal connector connection failure
		Power connector connection failure
		Supply power out of range
		Supply power quality failure
		HW fault in metering valve (if present)
		HW fault in proportioning valve (if present)
		HW fault in insulation and windings
		HW fault within hydraulic system (e.g. leak, clog)
		Over or under current
		Manufacturing variability
		Manufacturing defect
	Electromagnetic interference with other Brake system components	Over-emission of EMF
		Inadequate shielding

System/Subsystem	Failure Mode	Cause of Failure
	Mechanical failure	Out of scope
Disable VSA Button	None known that results in this specific malfunction	
Brake Booster	None known that results in this specific malfunction	
Master Cylinder / Hydraulic Reservoir	None known that results in this specific malfunction	
Brake Pedal Assembly	None known that results in this specific malfunction	
Brake Pads / Drums Assembly	Mechanical failure	Out of scope
Roll Rate Sensor	None known that results in this specific malfunction	
Yaw Rate Sensor	None known that results in this specific malfunction	
Lateral Acceleration Sensor	None known that results in this specific malfunction	
Longitudinal Acceleration Sensor	Measured longitudinal acceleration (g forward or rearward) value is lower than actual longitudinal acceleration	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in sensor I/Os connections
		Short in sensor I/Os connections to ground or voltage
		Short in I/Os connections to another connection

System/Subsystem	Failure Mode	Cause of Failure
		Signal connector connection failure
		Power connector connection failure
		Sensor output calculation algorithm fault
		SW parameters corrupted
		Supply power out of range
		Supply power quality failure
		EMC/EMI fault
		Contamination/Corrosion
		NVH fault
		Environmental temperature exposure failure
		Aging (durability)
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance
	Longitudinal Acceleration sensor communicates with Brake/Stability control module incorrectly	HW or SW fault (covered above)
		Communication bus fault

System/Subsystem	Failure Mode	Cause of Failure
Wheel Speed Sensors	Measured wheel speed value is higher than actual wheel speed.	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in sensor I/Os connections
		Short in sensor I/Os connections to ground or voltage
		Short in I/Os connections to another connection
		Signal connector connection failure
		Power connector connection failure
		Sensor output calculation algorithm fault
		SW parameters corrupted
		Supply power out of range
		Supply power quality failure
		EMC/EMI fault
		Contamination/Corrosion
		NVH fault
		Environmental temperature exposure failure
		Aging (durability)

System/Subsystem	Failure Mode	Cause of Failure
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance
	Wheel Speed sensors communicate with Brake/Stability control module incorrectly	HW or SW fault (covered above)
		Communication bus fault
Brake Pedal Position Sensor	Measured brake pedal position is higher than actual brake pedal position	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in sensor I/Os connections
		Short in sensor I/Os connections to ground or voltage
		Short in I/Os connections to another connection
		Signal connector connection failure
		Power connector connection failure
		Sensor output calculation algorithm fault
		Supply power out of range
		Supply power quality failure

System/Subsystem	Failure Mode	Cause of Failure
		EMC/EMI fault
		Contamination/Corrosion
		NVH fault
		Environmental temperature exposure failure
		Aging (durability)
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance
	Brake Pedal Position Sensor communicates with Brake/Stability control module incorrectly	HW or SW fault (covered above)
		Communication bus fault
Brake Pressure Sensor	Measured brake pressure is lower than actual brake pressure	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in sensor I/Os connections
		Short in sensor I/Os connections to ground or voltage
		Short in I/Os connections to another connection

System/Subsystem	Failure Mode	Cause of Failure
		Signal connector connection failure
		Power connector connection failure
		Sensor output calculation algorithm fault
		Supply power out of range
		Supply power quality failure
		EMC/EMI fault
		Contamination/Corrosion
		NVH fault
		Environmental temperature exposure failure
		Aging (durability)
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance
	Brake Pressure Sensor communicates with Brake/Stability control module incorrectly	HW or SW fault (covered above)
		Communication bus fault

Table H-5. FMEA for H5: Loss of Longitudinal Motion Control

System/Subsystem	Failure Mode	Cause of Failure
Brake/Stability Control Module (including ESC, ABS, and Traction Control)	Commands Accelerator Control System (ACS) to reduce torque when the vehicle is not in an ESC or TCS event	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in control module I/Os connections
		Short in control module I/Os connections to ground or voltage
		Short in control module I/Os connections to another connection
		Signal connector connection failure
		Power connector connection failure
		Arbitration logic fault
		Firmware crash/failure (SW parameters corrupted)
		Supply power out of range
		Supply power quality failure
		EMI/EMC fault
		Contamination/Corrosion
		NVH fault

System/Subsystem	Failure Mode	Cause of Failure
		Environmental temperature exposure failure
		Aging (durability)
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance
	Improperly intervenes based on poor inputs, resulting in torque reduction for ESC/TCS when no intervention is needed	HW or SW Fault (covered above)
	Miscommunicates with internal subsystems	From: Roll Rate Sensor
		From: Yaw Rate Sensor
		From: Lateral Acceleration Sensor
		From: Longitudinal Acceleration Sensor
		From: Wheel Speed Sensors
		To: Brake Modulator
	Miscommunicates steering wheel position	From: Steering System
	Miscommunicates differential braking request	From: Other Vehicle Systems (e.g. ALC/LKA, AEB, ACC)
	Miscommunicates with external systems	To: Steering System

System/Subsystem	Failure Mode	Cause of Failure
		To: Active Differential System
		To: Accelerator Control System (ACS/ETC) and Engine
	Diagnostic fault	Considered only in mitigation of multiple point failure analysis (FTA)
Brake Modulator	Transmits hydraulic pressure to single wheel when not needed	Internal connection fault (short or open)
		Signal connector connection failure
		Power connector connection failure
		Supply power out of range
		Supply power quality failure
		HW fault in metering valve (if present)
		HW fault in proportioning valve (if present)
		HW fault in insulation and windings
		HW fault within hydraulic system (e.g. leak, clog)
		Over or under current
		Manufacturing variability
		Manufacturing defect

System/Subsystem	Failure Mode	Cause of Failure
	Electromagnetic interference with other Brake system components	Over-emission of EMF
		Inadequate shielding
	Mechanical failure	Out of scope
Disable Stability Control Button	None known that results in this specific malfunction	
Brake Booster	None known that results in this specific malfunction	
Master Cylinder / Hydraulic Reservoir	None known that results in this specific malfunction	
Brake Pedal Assembly	None known that results in this specific malfunction	
Brake Pads / Drums Assembly	None known that results in this specific malfunction	
Roll Rate Sensor	Measured roll rate (deg/sec) value is higher than actual roll rate	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in sensor I/Os connections
		Short in sensor I/Os connections to ground or voltage
		Short in I/Os connections to another connection
		Signal connector connection failure

System/Subsystem	Failure Mode	Cause of Failure
		Power connector connection failure
		Sensor output calculation algorithm fault
		SW parameters corrupted
		Supply power out of range
		Supply power quality failure
		EMC/EMI fault
		Contamination/Corrosion
		NVH fault
		Environmental temperature exposure failure
		Aging (durability)
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance
	Measured roll rate (deg/sec) value is lower than actual roll rate	HW or SW fault (covered above)
	Roll rate sensor communicates with Brake/Stability control module incorrectly	HW or SW fault (covered above)

System/Subsystem	Failure Mode	Cause of Failure
		Communication bus fault
Yaw Rate Sensor	Measured yaw rate (deg/sec) value is higher than actual yaw rate	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in sensor I/Os connections
		Short in sensor I/Os connections to ground or voltage
		Short in I/Os connections to another connection
		Signal connector connection failure
		Power connector connection failure
		Sensor output calculation algorithm fault
		SW parameters corrupted
		Supply power out of range
		Supply power quality failure
		EMC/EMI fault
		Contamination/Corrosion
		NVH fault
		Environmental temperature exposure failure

System/Subsystem	Failure Mode	Cause of Failure
		Aging (durability)
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance
	Measured yaw rate (deg/sec) value is lower than actual yaw rate	HW or SW fault (covered above)
	Yaw rate sensor communicates with Brake/Stability control module incorrectly	HW or SW fault (covered above)
		Communication bus fault
Lateral Acceleration Sensor	Measured lateral acceleration (g to the left or right) value is higher than actual lateral acceleration	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in sensor I/Os connections
		Short in sensor I/Os connections to ground or voltage
		Short in I/Os connections to another connection
		Signal connector connection failure
		Power connector connection failure
		Sensor output calculation algorithm fault

System/Subsystem	Failure Mode	Cause of Failure
		SW parameters corrupted
		Supply power out of range
		Supply power quality failure
		EMC/EMI fault
		Contamination/Corrosion
		NVH fault
		Environmental temperature exposure failure
		Aging (durability)
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance
	Measured lateral acceleration (g to the left or right) value is lower than actual lateral acceleration	HW or SW fault (covered above)
	Lateral Acceleration sensor communicates with Brake/Stability control module incorrectly	HW or SW fault (covered above)
		Communication bus fault

System/Subsystem	Failure Mode	Cause of Failure
Longitudinal Acceleration Sensor	Measured longitudinal acceleration (g forward or rearward) value is higher than actual longitudinal acceleration	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in sensor I/Os connections
		Short in sensor I/Os connections to ground or voltage
		Short in I/Os connections to another connection
		Signal connector connection failure
		Power connector connection failure
		Sensor output calculation algorithm fault
		SW parameters corrupted
		Supply power out of range
		Supply power quality failure
		EMC/EMI fault
		Contamination/Corrosion
		NVH fault
		Environmental temperature exposure failure

System/Subsystem	Failure Mode	Cause of Failure
		Aging (durability)
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance
	Measured longitudinal acceleration (g forward or rearward) value is lower than actual longitudinal acceleration	HW or SW fault (covered above)
	Longitudinal Acceleration sensor communicates with Brake/Stability control module incorrectly	HW or SW fault (covered above)
		Communication bus fault
Wheel Speed Sensors	Measured wheel speed value is higher than actual wheel speed	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in sensor I/Os connections
		Short in sensor I/Os connections to ground or voltage
		Short in I/Os connections to another connection
		Signal connector connection failure
		Power connector connection failure

System/Subsystem	Failure Mode	Cause of Failure
		Sensor output calculation algorithm fault
		SW parameters corrupted
		Supply power out of range
		Supply power quality failure
		EMC/EMI fault
		Contamination/Corrosion
		NVH fault
		Environmental temperature exposure failure
		Aging (durability)
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance
	Measured wheel speed value is lower than actual wheel speed	HW or SW fault (covered above)
	Wheel Speed sensors communicate with Brake/Stability control module incorrectly	HW or SW fault (covered above)
		Communication bus fault

System/Subsystem	Failure Mode	Cause of Failure
Brake Pedal Position Sensor	None known that results in this specific malfunction	
Brake Pressure Sensor	None known that results in this specific malfunction	

Table H-6. FMEA for H6: Insufficient Vehicle Deceleration

System/Subsystem	Failure Mode	Cause of Failure
Brake/Stability Control Module (including ESC, ABS, and Traction Control)	Brake assist function does not operate sufficiently and/or within TBD time	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in control module I/Os connections
		Short in control module I/Os connections to ground or voltage
		Short in control module I/Os connections to another connection
		Signal connector connection failure
		Power connector connection failure
		Arbitration logic fault
		Firmware crash/failure (SW parameters corrupted)
		Supply power out of range
		Supply power quality failure
		EMI/EMC fault
		Contamination/Corrosion
		NVH fault

System/Subsystem	Failure Mode	Cause of Failure
		Environmental temperature exposure failure
		Aging (durability)
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance
	Improperly engages ABS when not needed (reduces available brake pressure)	HW or SW Fault (covered above)
	Improperly calculates ESC/TCS braking needs and delays braking at individual wheels (incorrectly using inputs from Longitudinal Acceleration Sensor, Wheel Speed Sensors, Brake Pedal Position, Measured Hydraulic Pressure, and/or other inputs)	HW or SW Fault (covered above)
	Miscommunicates with internal subsystems	From: Longitudinal Acceleration Sensor
		From: Wheel Speed Sensors
		From: Brake Pedal Position Sensor
		To: Brake Modulator
	Miscommunicates braking request	From: Other Vehicle Systems (e.g. ALC/LKA, AEB, ACC)
	Miscommunicates with external systems	To: Steering System

System/Subsystem	Failure Mode	Cause of Failure
		To: Active Differential System
		To: Accelerator Control System (ACS/ETC) and Engine
	Diagnostic fault	Considered only in mitigation of multiple point failure analysis (FTA)
Brake Modulator	Transmits too little pressure to wheels	Internal connection fault (short or open)
		Signal connector connection failure
		Power connector connection failure
		Supply power out of range
		Supply power quality failure
		HW fault in metering valve (if present)
		HW fault in proportioning valve (if present)
		HW fault in insulation and windings
		HW fault within hydraulic system (e.g. leak, clog)
		Over or under current
		Manufacturing variability
		Manufacturing defect
	Transmits pressure too late to wheels	HW fault (covered above)

System/Subsystem	Failure Mode	Cause of Failure
	Electromagnetic interference with other Brake system components	Over-emission of EMF
		Inadequate shielding
	Mechanical failure	Out of scope
Disable Stability Control Button	None known that results in this specific malfunction	
Brake Booster	Unable to boost brakes sufficiently	Insufficient vacuum due to leak, etc.
		Mechanical failure - out of scope
Master Cylinder / Hydraulic Reservoir	Unable to generate hydraulic pressure sufficient to overcome drive torque	Mechanical failure - out of scope
Brake Pedal Assembly	Assembly takes too much force to press to proper position for desired deceleration	Mechanical failure - out of scope
Brake Pads / Drums Assembly	Brake pads / drums are worn beyond their service life and cannot produce the desired deceleration torque	Mechanical failure - out of scope
Roll Rate Sensor	None known that results in this specific malfunction	
Yaw Rate Sensor	None known that results in this specific malfunction	
Lateral Acceleration Sensor	None known that results in this specific malfunction	

System/Subsystem	Failure Mode	Cause of Failure
Longitudinal Acceleration Sensor	Measured longitudinal acceleration (g forward or rearward) value is higher than actual longitudinal acceleration.	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in sensor I/Os connections
		Short in sensor I/Os connections to ground or voltage
		Short in I/Os connections to another connection
		Signal connector connection failure
		Power connector connection failure
		Sensor output calculation algorithm fault
		SW parameters corrupted
		Supply power out of range
		Supply power quality failure
		EMC/EMI fault
		Contamination/Corrosion
		NVH fault
		Environmental temperature exposure failure

System/Subsystem	Failure Mode	Cause of Failure
		Aging (durability)
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance
	Longitudinal Acceleration sensor communicates with Brake/Stability control module incorrectly	HW or SW fault (covered above)
		Communication bus fault
Wheel Speed Sensors	Measured wheel speed value is lower than actual wheel speed	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in sensor I/Os connections
		Short in sensor I/Os connections to ground or voltage
		Short in I/Os connections to another connection
		Signal connector connection failure
		Power connector connection failure
		Sensor output calculation algorithm fault
		SW parameters corrupted

System/Subsystem	Failure Mode	Cause of Failure
		Supply power out of range
		Supply power quality failure
		EMC/EMI fault
		Contamination/Corrosion
		NVH fault
		Environmental temperature exposure failure
		Aging (durability)
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance
	Measured wheel speed value is higher than actual wheel speed, resulting ABS intervention	HW or SW fault (covered above)
	Wheel Speed sensors communicate with Brake/Stability control module incorrectly	HW or SW fault (covered above)
		Communication bus fault
Brake Pedal Position Sensor	Measured brake pedal position indicates need for less braking than actually requested by driver	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)

System/Subsystem	Failure Mode	Cause of Failure
		Break in sensor I/Os connections
		Short in sensor I/Os connections to ground or voltage
		Short in I/Os connections to another connection
		Signal connector connection failure
		Power connector connection failure
		Sensor output calculation algorithm fault
		Supply power out of range
		Supply power quality failure
		EMC/EMI fault
		Contamination/Corrosion
		NVH fault
		Environmental temperature exposure failure
		Aging (durability)
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance

System/Subsystem	Failure Mode	Cause of Failure
	Brake pedal position sensor communicates with Brake/Stability control module incorrectly	HW or SW fault (covered above)
		Communication bus fault
Brake Pressure Sensor	None known that results in this specific malfunction	
Other Vehicle Systems	Request for braking is incorrect when received by CHB system	Communication Fault with CHB System
	Other system faults	Out of scope

Table H-7. FMEA for H7: Unintended Vehicle Propulsion

System/Subsystem	Failure Mode	Cause of Failure
Brake/Stability Control Module (including ESC, ABS, and Traction Control)	Requests an increase in torque when not needed	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in control module I/Os connections
		Short in control module I/Os connections to ground or voltage
		Short in control module I/Os connections to another connection
		Signal connector connection failure
		Power connector connection failure
		Arbitration logic fault
		Firmware crash/failure (SW parameters corrupted)
		Supply power out of range
		Supply power quality failure
		EMI/EMC fault
		Contamination/Corrosion
		NVH fault

System/Subsystem	Failure Mode	Cause of Failure
		Environmental temperature exposure failure
		Aging (durability)
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance
	Improperly calculates vehicle speed	HW or SW Fault (covered above)
	Miscommunicates with internal subsystems	From: Wheel Speed Sensors
	Miscommunicates with external systems	To: Accelerator Control System (ACS/ETC) and Engine
	Diagnostic fault	Considered only in mitigation of multiple point failure analysis (FTA)
Brake Modulator	None known that results in this specific malfunction	
Disable VSA Button	None known that results in this specific malfunction	
Brake Booster	None known that results in this specific malfunction	
Master Cylinder / Hydraulic Reservoir	None known that results in this specific malfunction	
Brake Pedal Assembly	None known that results in this specific malfunction	
Brake Pads / Drums Assembly	None known that results in this specific malfunction	

System/Subsystem	Failure Mode	Cause of Failure
Roll Rate Sensor	None known that results in this specific malfunction	
Yaw Rate Sensor	None known that results in this specific malfunction	
Lateral Acceleration Sensor	None known that results in this specific malfunction	
Longitudinal Acceleration Sensor	None known that results in this specific malfunction	
Wheel Speed Sensors	Measured wheel speed value is lower than actual wheel speed value	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in sensor I/Os connections
		Short in sensor I/Os connections to ground or voltage
		Short in I/Os connections to another connection
		Signal connector connection failure
		Power connector connection failure
		Sensor output calculation algorithm fault
		SW parameters corrupted
		Supply power out of range
		Supply power quality failure

System/Subsystem	Failure Mode	Cause of Failure
		EMC/EMI fault
		Contamination/Corrosion
		NVH fault
		Environmental temperature exposure failure
		Aging (durability)
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance
	Wheel Speed sensors communicate with Brake/Stability control module incorrectly	HW or SW fault (covered above)
		Communication bus fault
Brake Pedal Position Sensor	None known that results in this specific malfunction	
Brake Pressure Sensor	None known that results in this specific malfunction	
ACS/ETC	Does not provide requested torque adjustment	Communication Fault with CHB System
	Other system faults	Out of scope
Other Vehicle Systems	Request for braking is incorrect when received by CHB system	Communication Fault with CHB System

System/Subsystem	Failure Mode	Cause of Failure
	Other system faults	Out of scope

Table H-8. FMEA for H8: Insufficient Vehicle Propulsion

System/Subsystem	Failure Mode	Cause of Failure
Brake/Stability Control Module (including ESC, ABS, and Traction Control)	Commands ACS to reduce propulsion torque when not needed	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in control module I/Os connections
		Short in control module I/Os connections to ground or voltage
		Short in control module I/Os connections to another connection
		Signal connector connection failure
		Power connector connection failure
		Arbitration logic fault
		Firmware crash/failure (SW parameters corrupted)
		Supply power out of range
		Supply power quality failure
		EMI/EMC fault
		Contamination/Corrosion
		NVH fault

System/Subsystem	Failure Mode	Cause of Failure
		Environmental temperature exposure failure
		Aging (durability)
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance
	Incorrectly determines a TCS event exists	HW or SW Fault (covered above)
	Miscommunicates with internal sub-systems	From: Wheel Speed Sensors
		From: Disable VSA Button
	Miscommunicates with external systems	To: Accelerator Control System (ACS/ETC) and Engine
	Diagnostic fault	Considered only in mitigation of multiple point failure analysis (FTA)
Brake Modulator	None known that results in this specific malfunction	
Disable VSA Button	None known that results in this specific malfunction	
Brake Booster	None known that results in this specific malfunction	
Master Cylinder / Hydraulic Reservoir	None known that results in this specific malfunction	
Brake Pedal Assembly	None known that results in this specific malfunction	

System/Subsystem	Failure Mode	Cause of Failure
Brake Pads / Drums Assembly	None known that results in this specific malfunction	
Roll Rate Sensor	None known that results in this specific malfunction	
Yaw Rate Sensor	None known that results in this specific malfunction	
Lateral Acceleration Sensor	None known that results in this specific malfunction	
Longitudinal Acceleration Sensor	None known that results in this specific malfunction	
Wheel Speed Sensors	Measured wheel speed value is higher than actual wheel speed value	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in sensor I/Os connections
		Short in sensor I/Os connections to ground or voltage
		Short in I/Os connections to another connection
		Signal connector connection failure
		Power connector connection failure
		Sensor output calculation algorithm fault
		SW parameters corrupted

System/Subsystem	Failure Mode	Cause of Failure
		Supply power out of range
		Supply power quality failure
		EMC/EMI fault
		Contamination/Corrosion
		NVH fault
		Environmental temperature exposure failure
		Aging (durability)
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance
	Wheel Speed sensors communicate with Brake/Stability control module incorrectly	HW or SW fault (covered above)
		Communication bus fault
Brake Pedal Position Sensor	None known that results in this specific malfunction	
Brake Pressure Sensor	None known that results in this specific malfunction	
ACS/ETC	Does not provide requested torque adjustment	Communication Fault with CHB System

System/Subsystem	Failure Mode	Cause of Failure
	Other system faults	Out of scope
Other Vehicle Systems	Request for braking is incorrect when received by CHB system	Communication Fault with CHB System
	Other system faults	Out of scope

Table H-9. FMEA for H9: Vehicle Movement in Unintended Direction

System/Subsystem	Failure Mode	Cause of Failure
Brake/Stability Control Module (including ESC, ABS, and Traction Control)	Brake system does not operate sufficiently and/or within TBD time to support hill holder feature	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in control module I/Os connections
		Short in control module I/Os connections to ground or voltage
		Short in control module I/Os connections to another connection
		Signal connector connection failure
		Power connector connection failure
		Arbitration logic fault
		Firmware crash/failure (SW parameters corrupted)
		Supply power out of range
		Supply power quality failure
		EMI/EMC fault
		Contamination/Corrosion
		NVH fault

System/Subsystem	Failure Mode	Cause of Failure
		Environmental temperature exposure failure
		Aging (durability)
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance
	Improperly engages ABS when not needed (reduces available brake pressure)	HW or SW Fault (covered above)
	Miscommunicates with internal subsystems	From: Longitudinal Acceleration Sensor
		From: Wheel Speed Sensors
		From: Brake Pedal Position Sensor
		To: Brake Modulator
	Miscommunicates braking request	From: Other Vehicle Systems (e.g. ALC/LKA, AEB, ACC)
	Miscommunicates with external systems	To: Accelerator Control System (ACS/ETC) and Engine
	Diagnostic fault	Considered only in mitigation of multiple point failure analysis (FTA)
Brake Modulator	Transmits too little pressure to wheels	Internal connection fault (short or open)
		Signal connector connection failure

System/Subsystem	Failure Mode	Cause of Failure
		Power connector connection failure
		Supply power out of range
		Supply power quality failure
		HW fault in metering valve (if present)
		HW fault in proportioning valve (if present)
		HW fault in insulation and windings
		HW fault within hydraulic system (e.g. leak, clog)
		Over or under current
		Manufacturing variability
		Manufacturing defect
	Transmits pressure too late to wheels	HW fault (covered above)
	Electromagnetic interference with other Brake system components	Over-emission of EMF
		Inadequate shielding
	Mechanical failure	Out of scope
Disable Stability Control Button	None known that results in this specific malfunction	

System/Subsystem	Failure Mode	Cause of Failure
Brake Booster	None known that results in this specific malfunction	
Master Cylinder / Hydraulic Reservoir	None known that results in this specific malfunction	
Brake Pedal Assembly	None known that results in this specific malfunction	
Brake Pads / Drums Assembly	Brake pads / drums are worn beyond their service life and cannot produce the desired deceleration torque	Mechanical failure - out of scop
Roll Rate Sensor	None known that results in this specific malfunction	
Yaw Rate Sensor	None known that results in this specific malfunction	
Lateral Acceleration Sensor	None known that results in this specific malfunction	
Longitudinal Acceleration Sensor	Measured longitudinal acceleration (g forward or rearward) value is lower than actual longitudinal acceleration.	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in sensor I/Os connections
		Short in sensor I/Os connections to ground or voltage
		Short in I/Os connections to another connection
		Signal connector connection failure
		Power connector connection failure

System/Subsystem	Failure Mode	Cause of Failure
		Sensor output calculation algorithm fault
		SW parameters corrupted
		Supply power out of range
		Supply power quality failure
		EMC/EMI fault
		Contamination/Corrosion
		NVH fault
		Environmental temperature exposure failure
		Aging (durability)
		Manufacturing defect
		Manufacturing variability
		Service/Maintenance
	Longitudinal Acceleration sensor communicates with Brake/Stability control module incorrectly	HW or SW fault (covered above)
		Communication bus fault
Wheel Speed Sensors	None known that results in this specific malfunction	

System/Subsystem	Failure Mode	Cause of Failure
Brake Pedal Position Sensor	Measured brake pedal position indicates driver is still pressing the brakes	Hardware fault (Sensors, ICs, Circuit Components, Circuit Boards…)
		Internal connection fault (short or open)
		Break in sensor I/Os connections
		Short in sensor I/Os connections to ground or voltage
		Short in I/Os connections to another connection
		Signal connector connection failure
		Power connector connection failure
		Sensor output calculation algorithm fault
		Supply power out of range
		Supply power quality failure
		EMC/EMI fault
		Contamination/Corrosion
		NVH fault
		Environmental temperature exposure failure
		Aging (durability)
		Manufacturing defect

System/Subsystem	Failure Mode	Cause of Failure
		Manufacturing variability
		Service/Maintenance
	Brake pedal position sensor communicates with Brake/Stability control module incorrectly	HW or SW fault (covered above)
		Communication bus fault
Brake Pressure Sensor	None known that results in this specific malfunction	

APPENDIX I: STPA STEP 2: CAUSAL FACTORS

Table I-1: Brake Booster

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
654	Conflicting control action	Conflicting control action	If the brake booster can be electronically controlled by the brake/stability control module (i.e., instead of accumulating brake pressure via the brake modulator), the brake/stability control module command to the brake booster may conflict with the driver's command via the brake pedal.
655	Controlled component failure, change over time	Internal hardware failure	The brake booster may have an internal hardware failure that affects its ability to provide boost pressure to the driver (e.g., booster cannot hold vacuum).
656	Controlled component failure, change over time	Degradation over time	The brake booster may degrade over time (e.g., worn seals) affecting its ability to provide boost pressure to the driver (e.g., booster cannot hold vacuum).
657	Input to controlled process missing or wrong	Input to controlled process missing or wrong	The brake booster may not receive vacuum pressure from the engine or dedicated vacuum pump.
658	Output of controlled process contributes to system hazard	Output of controlled process contributes to system hazard	The brake booster may become jammed or stuck in a position, affecting the driver's ability to control the brake force.
659	External disturbances	Vibration or shock impact	Vibration or shock impact may affect the operation of the brake booster.
660	External disturbances	Manufacturing defects and assembly problems	Manufacturing defects or assembly problems may affect operation of the brake booster.
661	External disturbances	Extreme external temperature or thermal cycling	Extreme external temperatures or thermal cycling may affect operation of the brake booster.
662	External disturbances	Moisture, corrosion, or contamination	Moisture, corrosion, or contamination from the external environment may affect operation of the brake booster.
663	External disturbances	Physical interference (e.g., chafing)	Physical interference from the external environment (e.g., road debris) may affect operation of the brake booster.
664	Hazardous interaction with other components in the rest of the vehicle	Vibration or shock impact	Vibration or shock impact from other vehicle components may affect operation of the brake booster.
665	Hazardous interaction with other components in the rest of the vehicle	Physical interference (e.g., chafing)	Physical interference from other vehicle components may affect operation of the brake booster.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
666	Hazardous interaction with other components in the rest of the vehicle	Moisture, corrosion, or contamination	Moisture, corrosion, or contamination from other vehicle components may affect operation of the brake booster.
667	Hazardous interaction with other components in the rest of the vehicle	Excessive heat from other components	Excessive heat from other vehicle components may affect operation of the brake booster.

Table I-2: Brake Modulator

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
98	Actuator inadequate operation, change over time	Internal hardware failure	The brake modulator may have an internal hardware failure (e.g., solenoid or valve failure). This may affect the ability of the modulator to adjust the brake fluid pressure in the brake system.
99	Actuator inadequate operation, change over time	Degradation over time	The brake modulator may degrade over time (e.g., worn seals), affecting its ability to regulate the brake fluid pressure.
100	External disturbances	EMI or ESD	EMI or ESD from the external environment may affect the brake modulator (e.g., solenoid operation).
101	External disturbances	Vibration or shock impact	Vibration or shock impact from the external environment may affect the brake modulator (e.g., damage to a valve).
102	External disturbances	Manufacturing defects and assembly problems	Manufacturing defects or assembly problems may affect the ability for the brake modulator to properly regulate the brake fluid pressure.
103	External disturbances	Moisture, corrosion, or contamination	Moisture, corrosion, or contamination from the external environment may affect the brake modulator (e.g., causing seals to wear or preventing valves from seating properly).
104	External disturbances	Physical interference (e.g., chafing)	Physical interference from the external environment may damage the brake modulator, affecting its ability to regulate the brake fluid pressure.
105	Power supply faulty (high, low, disturbance)	Loss of 12-volt power	Loss of the low voltage power supply to the brake modulator may prevent the modulator from operating (e.g., solenoids/valves may rely on battery power).
106	Power supply faulty (high, low, disturbance)	Power supply faulty (high, low, disturbance)	A disturbance in the low voltage power supply to the brake modulator may prevent the modulator from operating properly (e.g., intermittent activation of solenoids/valves).

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
107	Hazardous interaction with other components in the rest of the vehicle	EMI or ESD	EMI or ESD from other vehicle components may affect the brake modulator (e.g., solenoid operation).
108	Hazardous interaction with other components in the rest of the vehicle	Vibration or shock impact	Vibration or shock impact from other vehicle components may affect the brake modulator (e.g., damage to a valve).
109	Hazardous interaction with other components in the rest of the vehicle	Moisture, corrosion, or contamination	Moisture, corrosion, or contamination from other vehicle components may affect the brake modulator (e.g., causing seals to wear or preventing valves from seating properly).
110	Hazardous interaction with other components in the rest of the vehicle	Physical interference (e.g., chafing)	Physical interference from other vehicle components may damage the brake modulator, affecting its ability to regulate the brake fluid pressure.
111	Hazardous interaction with other components in the rest of the vehicle	Magnetic interference	Magnetic interference from other vehicle components may affect the brake modulator, affecting its ability to regulate the brake fluid pressure (e.g., interference with solenoid operation).
224	Actuator inadequate operation, change over time	Relay failure modes, including: 1) does not energize, 2) does not de-energize, and 3) welded contacts	Relays within the brake modulator may fail (e.g., do not energize, do not de-energize, or become welded shut).

Table I-3: Brake Pads/Drum Assembly

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
112	Conflicting control action	Conflicting control action	The brake pads/drum assembly may respond to a conflicting control action from another vehicle system (e.g., the electronic parking brake system), preventing changes to the brake fluid pressure.
113	Controlled component failure, change over time	Internal hardware failure	The brake pads/drum assembly may have a hardware failure that affects its ability to apply brake force to the wheel.
114	Controlled component failure, change over time	Degradation over time	The brake pads/drum assembly may degrade over time (e.g., brake pad wear), reducing the effectiveness of applying brake force.
115	Controlled component failure, change over time	Other	Brake fade may reduce the effectiveness of the brake pads/drum.
116	External disturbances	Vibration or shock impact	Vibration or shock impact from the external environment may cause the brake pads/drum assembly to become misaligned with the wheel.
117	Input to controlled process missing or wrong	Input to controlled process missing or wrong	Degraded or incorrect brake fluid (e.g., trapped air, wrong fluid, overheated fluid) may affect the ability for the brake pads/drum to apply the correct amount of brake force.
118	External disturbances	Manufacturing defects and assembly problems	Manufacturing defects or assembly problems may affect the ability of the brake pads/drum assembly to apply brake force to the wheel.
119	External disturbances	Moisture, corrosion, or contamination	Moisture, corrosion, or contamination may affect the friction between the brake pads and disc.
120	External disturbances	Physical interference (e.g., chafing)	Physical interference from the external environment (e.g., road debris) may affect the alignment of the brake pad and disk.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
121	Hazardous interaction with other components in the rest of the vehicle	Vibration or shock impact	Vibration or shock impact from other vehicle components may affect the brake pad/drum assembly (e.g., causing misalignment).
122	Hazardous interaction with other components in the rest of the vehicle	Physical interference (e.g., chafing)	Physical interference with other vehicle components may affect the operation of the brake pads/drum assembly.
123	Hazardous interaction with other components in the rest of the vehicle	Moisture, corrosion, or contamination	Moisture, corrosion, or contamination from other vehicle components may affect the brake pads/drum assembly (e.g., reduce friction).
124	Hazardous interaction with other components in the rest of the vehicle	Excessive heat from other components	Excessive heat from other components (e.g., engine or power electronics) may contribute to brake fade.

Table I-4: Brake Pedal Mechanical Assembly

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
644	Actuator inadequate operation, change over time	Internal hardware failure	A hardware failure in the brake pedal mechanical assembly may affect its motion (e.g., pedal is stuck or loose).
645	Actuator inadequate operation, change over time	Degradation over time	The brake pedal mechanical assembly may degrade over time, affecting its motion (e.g., pedal is stuck or loose).
646	External disturbances	Vibration or shock impact	Vibration or shock impact from the external environment may affect the motion of the brake pedal.
647	External disturbances	Manufacturing defects and assembly problems	Manufacturing defects or assembly problems could affect the motion of the brake pedal (e.g., pedal stop is missing).
648	External disturbances	Extreme external temperature or thermal cycling	Extreme external temperatures or thermal cycling could affect the brake pedal mechanical assembly (e.g., expansion causing binding in the pedal shaft).
649	External disturbances	Moisture, corrosion, or contamination	Moisture, corrosion, or contamination from the external environment could affect the motion of the brake pedal mechanical assembly (e.g., condensation affecting motion of the pedal shaft).
650	External disturbances	Physical interference (e.g., chafing)	Physical interference from the external environment (e.g., foreign objects in the driver's footwell) may affect motion of the brake pedal.
651	Hazardous interaction with other components in the rest of the vehicle	Vibration or shock impact	Vibration or shock impact from other vehicle components may affect motion of the brake pedal assembly.
652	Hazardous interaction with other components in the rest of the vehicle	Physical interference (e.g., chafing)	Physical interference from other vehicle components may affect motion of the brake pedal assembly (e.g., trapping the pedal).

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
653	Hazardous interaction with other components in the rest of the vehicle	Moisture, corrosion, or contamination	Moisture, corrosion, or contamination from other vehicle components may affect motion of the brake pedal assembly.

Table I-5: Brake Pedal Position Sensor

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
175	Sensor inadequate operation, change over time	Internal hardware failure	The brake pedal position sensor may have an internal hardware failure (e.g., internal short circuit), resulting in an inaccurate brake pedal position measurement.
176	Sensor inadequate operation, change over time	Degradation over time	The brake pedal position sensor may degrade over time (e.g., worn contact on a potentiometer), resulting in an inaccurate brake pedal position measurement.
177	Sensor inadequate operation, change over time	Reporting frequency too low	The brake pedal position sensor reporting frequency may be too low, resulting in the brake/stability control module not receiving updated brake pedal position data.
178	External disturbances	EMI or ESD	EMI or ESD from the external environment may affect the brake pedal position sensor (e.g., if the sensor has an integrated circuit), resulting in an incorrect brake pedal position measurement.
179	External disturbances	Single event effects (e.g., cosmic rays, protons)	Single event effects (e.g., high energy particles) may affect internal logic states in the brake pedal position sensor, resulting in an incorrect brake pedal position measurement.
180	External disturbances	Vibration or shock impact	Vibration or shock impact from the external environment may affect the brake pedal position sensor measurement (e.g., sensor is displaced relative to the brake pedal).
181	External disturbances	Manufacturing defects and assembly problems	Manufacturing defects or assembly problems may affect the brake pedal position sensor, resulting in incorrect measurements of the brake pedal position.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
182	External disturbances	Extreme external temperature or thermal cycling	Extreme external temperature or thermal cycling may affect the brake pedal position sensor, resulting in an incorrect measurement of the brake pedal position.
183	External disturbances	Moisture, corrosion, or contamination	Moisture, corrosion, or contamination from the external environment may damage the brake pedal position sensor, resulting in an incorrect measurement of the brake pedal position.
184	External disturbances	Organic growth	Organic growth (e.g., fungi) may affect the brake pedal position sensor (e.g., damage to electronic subcomponents), resulting in an incorrect measurement of the brake pedal position.
185	External disturbances	Physical interference (e.g., chafing)	Physical interference from the external environment (e.g., objects in the footwell) may affect the brake pedal position sensor, resulting in an incorrect measurement of the brake pedal position.
186	External disturbances	Magnetic interference	Magnetic interference from the external environment may affect the brake pedal position sensor (e.g., hall effect type sensor), resulting in an incorrect measurement of the brake pedal position.
187	Power supply faulty (high, low, disturbance)	Loss of 12-volt power	The brake pedal position sensor may lose its low voltage power supply, affecting its ability to measure the brake pedal position (e.g., zero reading).
188	Power supply faulty (high, low, disturbance)	Power supply faulty (high, low, disturbance)	A disturbance in the low voltage power supply may affect the brake pedal position sensor (e.g., erratic brake pedal position measurements).
189	Power supply faulty (high, low, disturbance)	Reference voltage incorrect (e.g., too low, too high)	If the brake pedal position sensor relies on a reference voltage (e.g., a potentiometer-type sensor), an incorrect reference voltage may result in an incorrect brake pedal position measurement (e.g., an offset value).

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
190	Hazardous interaction with other components in the rest of the vehicle	EMI or ESD	EMI or ESD from other vehicle components may affect the brake pedal position sensor (e.g., if the sensor has an integrated circuit), resulting in an incorrect brake pedal position measurement.
191	Hazardous interaction with other components in the rest of the vehicle	Vibration or shock impact	Vibration or shock impact from other vehicle components may affect the brake pedal position sensor measurement (e.g., sensor is displaced relative to the brake pedal).
192	Hazardous interaction with other components in the rest of the vehicle	Physical interference (e.g., chafing)	Physical interference from other vehicle components may affect the brake pedal position sensor, resulting in an incorrect measurement of the brake pedal position.
193	Hazardous interaction with other components in the rest of the vehicle	Moisture, corrosion, or contamination	Moisture, corrosion, or contamination from other vehicle components may damage the brake pedal position sensor, resulting in an incorrect measurement of the brake pedal position.
194	Hazardous interaction with other components in the rest of the vehicle	Magnetic interference	Magnetic interference from other vehicle components may affect the brake pedal position sensor (e.g., hall effect type sensor), resulting in an incorrect measurement of the brake pedal position.
195	Hazardous interaction with other components in the rest of the vehicle	Excessive heat from other components	Excessive heat from other vehicle components may affect the brake pedal position sensor, resulting in an incorrect measurement of the brake pedal position.
196	Hazardous interaction with other components in the rest of the vehicle	Electrical arcing from neighboring components or exposed terminals	Electrical arcing from neighboring components or exposed terminals may damage the brake pedal position sensor, resulting in an incorrect measurement of the brake pedal position.

Table I-6: Brake Pressure Sensor

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
534	Sensor inadequate operation, change over time	Internal hardware failure	An internal hardware failure in the brake pressure sensor may affect the brake/stability control module's ability to determine the driver's intent (e.g., hard braking).
535	Sensor inadequate operation, change over time	Overheating due to increased resistance in a subcomponent or internal shorting	The brake pressure sensor may overheat as a result of increased resistance or shorting of an electronic subcomponent. This may affect the brake/stability control module's ability to determine the driver's intent (e.g., hard braking).
536	Sensor inadequate operation, change over time	Degradation over time	The brake pressure sensor may degrade over time, affecting the brake/stability control module's ability to determine the driver's intent (e.g., hard braking).
537	Sensor inadequate operation, change over time	Reporting frequency too low	The reporting frequency for the brake pressure sensor may be too low, introducing a delay in the brake/stability control module's ability to determine the driver's intent (e.g., hard braking).
538	External disturbances	EMI or ESD	EMI or ESD from the external environment may affect the brake pressure sensor. This may affect the brake/stability control module's ability to determine the driver's intent (e.g., hard braking).
539	External disturbances	Single event effects (e.g., cosmic rays, protons)	Single event effects may affect internal logic circuits in the brake pressure sensor (e.g., evaluation circuits). This may affect the brake/stability control module's ability to determine the driver's intent (e.g., hard braking).
540	External disturbances	Vibration or shock impact	Vibration or shock impact from the external environment may damage the brake pressure sensor. This may affect the brake/stability control module's ability to determine the driver's intent (e.g., hard braking).

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
541	External disturbances	Manufacturing defects and assembly problems	Manufacturing defects or assembly problems may affect the brake pressure sensor. This may affect the brake/stability control module's ability to determine the driver's intent (e.g., hard braking).
542	External disturbances	Extreme external temperature or thermal cycling	Extreme external temperatures or thermal cycling may affect the brake pressure sensor (e.g., extreme cold). This may affect the brake/stability control module's ability to determine the driver's intent (e.g., hard braking).
543	External disturbances	Moisture, corrosion, or contamination	Moisture, corrosion, or contamination from the external environment may affect the brake pressure sensor. This may affect the brake/stability control module's ability to determine the driver's intent (e.g., hard braking).
544	External disturbances	Organic growth	Organic growth may damage the brake pressure sensor. This may affect the brake/stability control module's ability to determine the driver's intent (e.g., hard braking).
545	External disturbances	Physical interference (e.g., chafing)	Physical interference from the external environment (e.g., road debris) may damage or displace the brake pressure sensor. This may affect the brake/stability control module's ability to determine the driver's intent (e.g., hard braking).
546	Power supply faulty (high, low, disturbance)	Loss of 12-volt power	The brake pressure sensor may lose the low voltage (e.g., 12-volt) power supply. This may affect the brake/stability control module's ability to determine the driver's intent (e.g., hard braking).
547	Power supply faulty (high, low, disturbance)	Power supply faulty (high, low, disturbance)	A disruption in the low voltage (e.g., 12-volt) power supply may affect the brake pressure sensor. This may affect the brake/stability control module's ability to determine the driver's intent (e.g., hard braking).

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
548	Hazardous interaction with other components in the rest of the vehicle	EMI or ESD	EMI or ESD from other vehicle components may affect the brake pressure sensor. This may affect the brake/stability control module's ability to determine the driver's intent (e.g., hard braking).
549	Hazardous interaction with other components in the rest of the vehicle	Vibration or shock impact	Vibration or shock impact from other vehicle components may damage the brake pressure sensor. This may affect the brake/stability control module's ability to determine the driver's intent (e.g., hard braking).
550	Hazardous interaction with other components in the rest of the vehicle	Excessive heat from other components	Excessive heat from other vehicle components may affect the brake pressure sensor. This may affect the brake/stability control module's ability to determine the driver's intent (e.g., hard braking).
551	Hazardous interaction with other components in the rest of the vehicle	Moisture, corrosion, or contamination	Moisture, corrosion, or contamination from other vehicle components may damage the brake pressure sensor. This may affect the brake/stability control module's ability to determine the driver's intent (e.g., hard braking).
552	Hazardous interaction with other components in the rest of the vehicle	Physical interference (e.g., chafing)	Physical interference from other vehicle components may damage or displace the brake pressure sensor. This may affect the brake/stability control module's ability to determine the driver's intent (e.g., hard braking).
553	Hazardous interaction with other components in the rest of the vehicle	Electrical arcing from neighboring components or exposed terminals	Electrical arcing from other vehicle components or exposed terminals may damage the brake pressure sensor. This may affect the brake/stability control module's ability to determine the driver's intent (e.g., hard braking).

Table I-7: CHB Control Module

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
1	External control input or information wrong or missing	Timing related input is incorrect or missing	If the brake/stability control module depends on an external timing signal for determining how long to reduce brake pressure at one or more wheels, this signal may be incorrect or missing.
2	External disturbances	EMI or ESD	EMI or ESD from the external environment may affect the brake/stability control module.
3	External disturbances	Single event effects (e.g., cosmic rays, protons)	Single event effects may affect the logic circuits of the brake/stability control module.
4	External disturbances	Vibration or shock impact	Vibration or shock impact from the external environment may damage the brake/stability control module, affecting its ability to correctly function.
5	External disturbances	Manufacturing defects and assembly problems	Manufacturing defects or assembly problems may affect the correct functioning of the brake/stability control module.
6	External disturbances	Extreme external temperature or thermal cycling	Extreme external temperatures or thermal cycling may affect the function of the brake/stability control module (e.g., overheating).
8	External disturbances	Moisture, corrosion, or contamination	Moisture, corrosion, or contamination from the external environment may affect the brake/stability control module (e.g., causing shorting, premature degradation of electronic subcomponents, etc.).
9	External disturbances	Organic growth	Organic growth in the brake/stability control module (e.g., mold or fungi) may affect its correct functioning (e.g., causing shorting between pins).
10	External disturbances	Physical interference (e.g., chafing)	Physical interference from the external environment (e.g., road debris) may damage the brake/stability control module, affecting its ability to function correctly.
11	Power supply faulty (high, low, disturbance)	Loss of 12-volt power	If the brake/stability control module loses the low voltage power supply, it may not be able to issue controls the brake modulator (e.g., close the valves) or may prematurely terminate a control action.
12	Power supply faulty (high, low, disturbance)	Power supply faulty (high, low, disturbance)	A disturbance in the low voltage power supply to the brake/stability control module may affect its ability to function correctly (e.g., reset the controller, affect stored data, etc.).
13	Hazardous interaction with other components in the rest of the vehicle	EMI or ESD	EMI or ESD from other vehicle components may affect the brake/stability control module.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
14	Hazardous interaction with other components in the rest of the vehicle	Vibration or shock impact	Vibration or shock impact from other vehicle components may damage the brake/stability control module, affecting its ability to function correctly.
15	Hazardous interaction with other components in the rest of the vehicle	Physical interference (e.g., chafing)	Physical interference with other vehicle components could affect the brake/stability control module, affecting its ability to function correctly.
16	Hazardous interaction with other components in the rest of the vehicle	Moisture, corrosion, or contamination	Moisture, corrosion, or contamination from other vehicle components may affect the brake/stability control module (e.g., internal shorting, premature degradation of electronic subcomponents, etc.).
17	Hazardous interaction with other components in the rest of the vehicle	Excessive heat from other components	Excessive heat from other vehicle components may affect the brake/stability control module (e.g., over temperature, melting plastic subcomponents, etc.).
18	Hazardous interaction with other components in the rest of the vehicle	Electrical arcing from neighboring components or exposed terminals	Electrical arcing from neighboring components or exposed terminals may damage the brake/stability control module.
19	Controller hardware faulty, change over time	Internal hardware failure	The brake/stability control module may have an internal hardware failure (e.g., failure of to an electronic subcomponent), affecting its ability to function correctly.
20	Controller hardware faulty, change over time	Overheating due to increased resistance in a subcomponent or internal shorting	The brake/stability control module may overheat as the result of increased resistance in a subcomponent or internal shorting.
21	Controller hardware faulty, change over time	Over temperature due to faulty cooling system	A faulty cooling system may result in the brake/stability control module overheating.
22	Controller hardware faulty, change over time	Degradation over time	Electronic subcomponents in the brake/stability control module may degrade over time, affecting its ability to function correctly.
23	Controller hardware faulty, change over time	Faulty memory storage or retrieval	A fault or error may occur when storing or retrieving data from memory.
24	Controller hardware faulty, change over time	Faulty internal timing clock	The internal timing clock for the brake/stability control module may be faulty, affecting the timing of control actions.
25	Controller hardware faulty, change over time	Faulty signal conditioning or converting (e.g., analog-to-digital converter, signal filters)	Faults or errors may occur when converting analog signals to digital signals.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
26	Controller hardware faulty, change over time	Unused circuits in the controller	Unused circuits in the controller may affect the function of the brake/stability control module (e.g., ungrounded circuits may "float" causing input noise or increasing EMI).
27	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module may incorrectly determine which region of the mu-slip curve the wheel is currently in.
28	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The ABS control algorithm may incorrectly determine that allowing the wheels to lock may provide better stopping ability (e.g., the brake/stability control module thinks the vehicle is on a deformable surface).
29	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	A fault in the ABS control algorithm may affect the duration over which the brake pressure is increased or reduced (e.g., timing control is too short or too long).
30	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The brake/stability control module may interrupt the ABS function to respond to the request of another vehicle system or other internal brake system.
31	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Flaws in software code creation	Flaws may be introduced during software code creation (e.g., automatic code generation, internal compiler error, etc.).
32	Process model or calibration incomplete or incorrect	Sensor or actuator calibration, including degradation characteristics	The wheel speed sensor calibration in the brake/stability control module (including degradation characteristics) may be incorrect.
33	Process model or calibration incomplete or incorrect	Errors in stored maps	If the brake/stability control module uses stored maps for determining ABS parameters (e.g., mu-slip curve values), faults in these maps may affect the ABS function.
48	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module parameters for the tire size may be different from the actual tire size (e.g., diameter, snow tires, undersized spare, etc.). This may affect the determination of whether or not ESC, ABS, or TCS should engage, and may also affect vehicle speed calculations.
93	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module may have an incorrect model for how quickly the brake pressure can be changed at the wheel (e.g., increased or reduced).

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
94	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The ABS control algorithm may have the incorrect timing when controlling the brake pressure (e.g., incorrect start time).
95	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The brake/stability control module may unintentionally introduce a delay when processing or arbitrating incoming braking requests from other vehicle systems.
97	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The brake/stability control module may unintentionally introduce a delay when resolving simultaneous requests from other vehicle systems or internal brake system functions (including conflicting requests).
162	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The control algorithm may not properly control lowering the brake fluid pressure to zero (e.g., when the brake pedal is released). For example, the release valve may close too soon, trapping brake fluid in the brake corner.
163	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module may incorrectly think the release valve is open.
164	External control input or information wrong or missing	Corrupted input signal	The input signal from another vehicle system may become corrupted, causing the brake/stability control module to receive incorrect data (e.g., incorrect braking request).
165	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The control algorithm may not correctly control the brake pressure when the driver is not applying the brakes (e.g., the algorithm may require a parameter such as brake pedal position or may only operate within a set range above the driver's braking command).
166	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module may not check the current brake fluid pressure in the system when responding to a braking request from another vehicle system.
167	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The control algorithm may have an incorrect value for the current brake fluid pressure.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
168	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The brake/stability control module may incorrectly resolve conflicting requests from other vehicle systems (e.g., to increase and decrease brake pressure).
169	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The control algorithm may incorrectly reduce the brake fluid pressure to zero when the driver is not pressing the brakes, even if another vehicle system or internal brake function is trying to retain some brake fluid pressure.
170	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module may incorrectly think the release valve is closed.
171	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module may not realize the brake fluid pressure can be reduced further (e.g., controller incorrectly thinks the pressure is at zero and closes the valves).
172	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The control algorithm may continue in its previous state (e.g., decrease pressure) if it does not receive updated data (e.g., wheel speed sensor reading). This may also cause a delay before the brake/stability control module updates a control action.
173	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module may not realize the brake pedal is pressed.
174	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The brake/stability control module may incorrectly compute the wheel speed from the sensor data (e.g., incorrect conversion of input to wheel speed).
225	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module may not issue a command to decrease the brake fluid pressure to the rear wheels if it incorrectly thinks the electronic parking brake is engaged.
226	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The brake/stability control module may incorrectly resolve simultaneous requests between the driver, and other vehicle systems or internal brake functions (this includes conflicting requests).

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
228	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module may limit how much the brake pressure can be reduced because it incorrectly thinks the brake pedal is pressed.
229	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The brake/stability control module may unintentionally introduce a delay when increasing the brake fluid pressure following an ABS event (e.g., hysteresis).
230	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The ABS control algorithm may include too large of a buffer around the peak of the mu-slip curve (e.g., stops brake pressure accumulation well before the mu-slip curve peak).
231	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module may incorrectly enter a fault or stand-by state, preventing it from issuing commands to the brake modulator or from calculating the vehicle speed.
232	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The brake/stability control module may not respond to requests for braking from other vehicle systems or internal functions if the driver is not pressing the brake pedal.
233	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module may not increase or reduce the brake fluid pressure if it thinks the brake fluid is already at the target pressure.
234	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module may incorrectly think the inlet/hold valve is open.
235	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module may incorrectly think the inlet/hold valve is closed.
236	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The brake/stability control module may not properly resolve conflicting wheel speed values from multiple sensors (e.g., all sensors report different values).

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
237	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The vehicle speed algorithm may improperly compute the vehicle speed (e.g., flaw in software logic).
238	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	Critical vehicle parameters used for calculating the vehicle speed may be incorrectly programmed into the brake/stability control module.
239	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The vehicle speed calculation algorithm may introduce a delay when calculating the vehicle speed.
268	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The vehicle speed calculation may not update fast enough during sudden changes in vehicle speed.
269	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The process model for determining the vehicle speed may not take into account that certain wheels may be slipping or spinning.
270	Process model or calibration incomplete or incorrect	Errors in stored maps	If the brake/stability control module uses stored maps for determining traction control parameters (e.g., mu-slip curve values), faults in these maps may affect the traction control function.
271	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The traction control algorithm may have a delay when updating the wheel slip calculations.
272	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The traction control algorithm may incorrectly calculate the amount by which the brake pressure needs to be increased or reduced.
274	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	A fault in the traction control algorithm may affect the duration over which the brake pressure is increased or reduced (e.g., timing control is too short or too long).

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
275	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The brake/stability control module may not activate the traction control function without a clear indication that the driver or another vehicle system is trying to accelerate the vehicle (e.g., both the accelerator and brake pedals are pressed).
276	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The brake/stability control module may control the brake pressure in the wrong direction.
277	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The brake/stability control module may interrupt the traction control function to respond to the request of another vehicle system or other internal brake system.
307	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The stability or traction control feature may be disabled while in the middle of a stability or traction control event. This may prevent the brake pressure in the brake corner from being changed.
308	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The brake/stability control module may interrupt the stability control function to respond to the request of another vehicle system or other internal brake system.
309	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The brake/stability control module may incorrectly resolve conflicting requests between other vehicle systems and internal brake functions.
310	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The brake/stability control module may incorrectly compute the vehicle's yaw error.
311	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module may incorrectly determine the direction of the vehicle's yaw.
312	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module may not recognize that yaw stabilization is needed (e.g., may incorrectly think yaw error is below a threshold value).

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
313	Process model or calibration incomplete or incorrect	Sensor or actuator calibration, including degradation characteristics	The yaw rate or lateral acceleration sensor calibration in the brake/stability control module (including degradation characteristics) may be incorrect.
314	Process model or calibration incomplete or incorrect	Sensor or actuator calibration, including degradation characteristics	The steering wheel angle sensor calibration in the brake/stability control module (including degradation characteristics) may be incorrect.
315	Process model or calibration incomplete or incorrect	Sensor or actuator calibration, including degradation characteristics	The brake pressure sensor calibration in the brake/stability control module (including degradation characteristics) may be incorrect.
316	Process model or calibration incomplete or incorrect	Errors in stored maps	If the brake/stability control module uses stored maps for determining stability control parameters (e.g., yaw rate values), faults in these maps may affect the stability control function.
318	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module may expect another vehicle system (e.g., Active Differential System) to intervene to correct the yaw rate error or implement a yaw/differential braking command from another vehicle system.
520	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	An error in the control algorithm may affect how the brake/stability control module responds to braking requests from other vehicle systems (e.g., wrong duration or amount).
521	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module may not respond to requests from other vehicle systems if it thinks that implementing the request may affect vehicle stability (e.g., if the yaw error is zero during a dynamic maneuver, the brake/stability system may not generate additional yaw).
522	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module may incorrectly think the vehicle is at a dynamic limit (e.g., lateral acceleration limit) and elect not to implement a braking or yaw request from another system.
523	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The brake/stability control module may incorrectly convert the braking request from another vehicle system to a differential braking command.
524	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability system may wait for the other vehicle system to confirm the commanded braking request (including yaw/differential braking requests) was met before terminating the braking action.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
525	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The ESC control algorithm may introduce a delay when computing the yaw error.
526	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The vehicle speed calculation algorithm may introduce a delay when determining or updating the driver's intent (e.g., the algorithm has to monitor inputs over a period of time before initiating a corrective action).
527	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The brake/stability control module may interrupt execution of braking requests from other vehicle systems when the driver presses the brake pedal.
528	External control input or information wrong or missing	Malicious Intruder	A malicious intruder may access the brake/stability control module, affecting its ability to properly issue commands.
529	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module may not respond to requests from other vehicle systems when the brake pedal is pressed (e.g., prioritize driver's braking). This includes responding to other systems which may have a higher priority or may not conflict with the driver's braking command.
530	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The prioritization strategy in the brake/stability control module may be incorrect.
531	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The brake/stability control module may control the brake pressure to the wrong wheels.
532	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	A fault in the stability control algorithm may affect the duration over which the brake pressure is controlled to correct the vehicle's yaw (e.g., timing control is too short or too long).

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
533	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability system may implement a yaw/differential braking request from another vehicle system after it corrects the vehicle's yaw error, resulting in a net yaw/differential braking event that lasts too long or provides too much yaw.
554	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability system may not compare the vehicle's yaw response with the yaw/differential braking requested by another vehicle system.
555	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The brake/stability control module may incorrectly determine the relationship between brake force and vehicle yaw.
556	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module may not properly resolve conflicting data from vehicle sensors (e.g., lateral acceleration and yaw rate).
557	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module may incorrectly perceive implementation of another vehicle system's yaw request (either through the braking or steering system) as a yaw error with the driver's intended path. The brake/stability control module may request differential braking in the opposite direction in an attempt to correct the perceived error.
576	Process model or calibration incomplete or incorrect	Errors in stored maps	If the brake/stability control module uses stored maps (e.g., mu characteristics) for determining the amount of braking to apply in response to requests from other vehicle systems, faults in these maps may affect the braking force generated.
577	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module may incorrectly enter a fault or stand-by state, causing the system to reduce the brake pressure in the system.
578	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The brake/stability control module may interrupt the driver's braking request to respond to braking requests from other vehicle systems.
579	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	If the starting brake pressure is more than the brake pressure commanded by the driver, the brake/stability control system may allow the brake pressure to be reduced even if the brake pedal is pressed.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
580	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module may not respond to requests from other vehicle systems when the brake pedal is not pressed (e.g., prioritize driver's braking). This includes responding to other systems which may have a higher priority or may not conflict with the driver's braking command.
581	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The traction control feature may not activate if it incorrectly thinks the brake pedal is pressed.
582	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	If the brake/stability control module is also requesting a reduction in engine torque to support the traction control function, the amount of engine torque reduction may be less than the brake/stability control module expects.
583	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The traction control feature may not activate if it incorrectly thinks that the accelerator pedal is pressed or another system is requesting acceleration.
584	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module may have an incorrect model of the current brake system characteristics (e.g., brake pad wear, wet discs, etc.). This may cause the brake/stability control module to command an incorrect braking force (too much or too little).
585	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The control algorithm may fail to proportion the braking force between the front and rear wheels, resulting in an overall braking force that is too low.
586	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The brake/stability control module may incorrectly compute the amount of torque reduction or increase required (e.g., based on current wheel speed).
587	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module estimation of the current engine speed may be incorrect (e.g., if the brake/stability control estimates a lower engine speed, that may limit the amount of torque reduction that can be requested).
588	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The torque increase or reduction required to support a brake function may be more than the brake/stability control module's authority limit for increasing or decreasing the torque.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
589	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module may incorrectly attempt to control wheel slip or spin through another brake function (e.g., if the control module incorrectly thinks the brakes are applied, it may try to operate ABS instead of drag-torque control).
590	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	A delay may occur when the brake/stability control module computes the amount of torque reduction or increase required to support a braking function.
591	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module may have an incorrect process model for how quickly the engine torque can be changed.
592	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	A fault in the control algorithm may prevent the brake/stability control module from adjusting the torque output.
593	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The brake/stability control module may not properly control engine torque when executing a braking request from another vehicle system (e.g., the brake pedal position signal may be missing).
594	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	Increasing the engine torque may have a conflict with higher priority braking requests (e.g., crash-imminent braking).
595	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module may incorrectly determine a need to adjust engine torque when the wheels are not slipping or spinning.
596	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module may misinterpret braking action as sudden engine deceleration (e.g., if the brake pedal position signal is missing).
597	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	A fault in the control algorithm may affect the duration over which the brake/stability control module adjusts the torque output.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
598	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	There may be a delay before the brake/stability control module recognizes the effect of its engine torque adjustment (e.g., the control module waits for detecting change in wheel speed before changing the torque request).
613	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module may interrupt a torque reduction request if it incorrectly thinks there is a conflicting request to accelerate the vehicle (e.g., ACC issues a command to resume acceleration).
614	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module may interrupt or not issue a torque reduction request if it incorrectly thinks there is a conflicting request to accelerate the vehicle (e.g., ACC issues a command to resume acceleration).
615	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability system may have an incorrect model for the amount of steering torque required to produce a certain amount of vehicle yaw.
616	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The brake/stability control module may incorrectly compute the amount of yaw compensation provided by the steering system, braking/stability system, and active differential system.
617	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability system may incorrectly identify the road surface conditions, affecting requests for steering to compensate for perceived braking yaw (e.g., split-mu surface).
618	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	The brake/stability control module may introduce a delay when computing the amount of steering assist required to support a braking function.
619	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability system may interrupt a steering request to respond to braking commands from the driver or other vehicle systems.
620	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability system may have an incorrect model for how quickly steering intervention affects the vehicle's yaw.
621	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module may incorrectly enter a fault or stand-by state, preventing the brake/stability control module from requesting steering adjustments.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
634	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module may not command steering if it thinks that implementing the request may affect vehicle stability or that the vehicle is at a dynamic limit.
747	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The brake/stability control module may incorrectly activate the brake disc wiping function. For example, the brake/stability control module may think it's raining if it receives bad data from the rain sensor.
749	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	If the other vehicle systems or internal brake system functions do not realize that the brake system is in a degraded mode (e.g., only one brake circuit is available), the braking request may not be issued with the appropriate starting time or braking force required to stop the vehicle.
750	Software error (inadequate control algorithm, flaws in creation, modification, or adaptation)	Inadequate control algorithm	If a side-slip estimate is used for determining ESC or yaw stabilization intervention, the side-slip may be incorrectly calculated from sensor data.
751	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The ESC or yaw stabilization feature may be unable to fully correct the yaw error (e.g., the amount of correction needed exceeds the braking authority or dynamic limits of the vehicle).

Table I-8: Disable Stability Control Switch

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
298	Sensor inadequate operation, change over time	Internal hardware failure	If the brake/stability control system can be disabled via a dashboard button, a hardware failure in the button may cause the stability control system to activate/deactivate.
299	Sensor inadequate operation, change over time	Degradation over time	If the brake/stability control system can be disabled via a dashboard button, the button may degrade over time, resulting in activation/deactivation of the stability control system (e.g., stuck in the "off" position).
300	External disturbances	Vibration or shock impact	If the brake/stability control system can be disabled via a dashboard button, vibration or shock impact from the external environment may cause the button to inadvertently actuate, activating/disabling the stability system.
301	External disturbances	Manufacturing defects and assembly problems	If the brake/stability control system can be disabled via a dashboard button, manufacturing defects or assembly problems may affect actuation of the button (e.g., the button becomes stuck), causing the stability control system to activate/deactivate.
302	External disturbances	Moisture, corrosion, or contamination	If the brake/stability control system can be disabled via a dashboard button, moisture, corrosion, or contamination from the external environment (e.g., spilled beverages in the vehicle cabin) may damage the button (e.g., causing shorting), inadvertently activating/disabling stability control.
303	External disturbances	Physical interference (e.g., chafing)	If the brake/stability control system can be disabled via a dashboard button, physical interference from the external environment (e.g., objects in the vehicle cabin) may inadvertently actuate the button, activating/disabling stability control.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
304	Hazardous interaction with other components in the rest of the vehicle	Vibration or shock impact	If the brake/stability control system can be disabled via a dashboard button, vibration or shock impact from other vehicle components may cause the button to inadvertently actuate, activating/disabling the stability system.
305	Hazardous interaction with other components in the rest of the vehicle	Moisture, corrosion, or contamination	If the brake/stability control system can be disabled via a dashboard button, moisture, corrosion, or contamination from other vehicle components (e.g., A/C condensation) may damage the button (e.g., causing shorting), inadvertently activating/disabling stability control.
306	Hazardous interaction with other components in the rest of the vehicle	Physical interference (e.g., chafing)	If the brake/stability control system can be disabled via a dashboard button, physical interference from other vehicle components may inadvertently actuate the button, activating/disabling stability control.

Table I-9: Driver

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
635	External control input or information wrong or missing	Other	The lead vehicle may incorrectly indicate that it is no longer decelerating (e.g., brake lights are not working).
636	External control input or information wrong or missing	Other	If the driver is relying on vehicle systems (e.g., back-up cameras) to determine the need for braking, these systems may provide the incorrect information to the driver.
637	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The driver may misinterpret dashboard displays and think the brake/stability control system or another vehicle system has taken over braking activities (e.g., Hill Hold Assist, Traffic Jam Assist).
638	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The driver may not expect the vehicle to accelerate as the brake pedal angular position is reduced (e.g., if cruise control did not deactivate properly).
639	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The driver may have an incorrect understanding of the vehicle's creep speed (e.g., may roll forward more than expected, or may roll backwards on a slope).
640	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The driver may not understand how other systems (e.g., hill hold assist, traffic jam assist) control the vehicle's braking (e.g., braking authority, when the system engages, etc.).
641	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	Changes in the brake system performance (e.g., faults, worn pads) may affect the rate at which the brake force increases or reduces. This may cause the driver to operate the brakes with the wrong timing or incorrectly press the brake pedal.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
642	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	Delays in the brake system's response may cause the driver to continue to reduce the brake pedal position to achieve the desired reduction in brake force.
643	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The driver may be startled by the brake system performance (e.g., pedal vibration from ABS activation), causing them to an incorrect amount of force to the brake pedal.
711	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The driver may be waiting for another vehicle system (e.g., ACC or traffic jam assist) to provide the required braking response. For instance, the driver may be accustomed to assist systems intervening in similar circumstances.
712	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The driver may not be paying attention to the roadway (e.g., Level 3 automation). This may delay the driver's reaction or prevent the driver from reacting in a critical driving situation.
713	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The driver may not have confidence in a brake assist function (e.g., brake assist or panic brake assist) and apply the brakes with greater force than necessary.
714	External control input or information wrong or missing	Other	The lead vehicle may incorrectly indicate that it is braking (e.g., brake lights illuminate), causing the driver to apply the brakes.
715	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The driver may not have confidence in the braking ability of other vehicle systems or may not expect another vehicle system to intervene, causing the driver to apply the brakes unnecessarily.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
717	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The driver may not know the proper way to activate/deactivate stability control (e.g., the button may require the driver to press and hold as a confirmation mechanism).
718	External control input or information wrong or missing	Other	The driver may be confused by the dashboard indicator lights and think that stability control has changed states (i.e., has become enabled/disabled).
719	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The driver may have the wrong understanding of how the vehicle handles with stability control engaged or disengaged. The driver may continue to actuate the stability control button if they do not like the vehicle's handling response.
720	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	If the driver does not notice (or receive) visual confirmation that the brake/stability control system has changed states (e.g., dashboard light), the driver may press the button repeatedly, or with increasing force or for longer durations.
721	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	In a panic situation, the driver may press the button with more force or longer than necessary, damaging the actuator.
722	Process model or calibration incomplete or incorrect	Model of the controlled process, including degradation characteristics	The driver may think they're pressing a button for a different vehicle feature, and accidentally press the stability control button.

Table I-10: Lateral Acceleration Sensor

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
317	Sensor inadequate operation, change over time	Internal hardware failure	The lateral acceleration sensor may have an internal hardware failure, affecting its measurement of the vehicle's lateral acceleration.
319	Sensor inadequate operation, change over time	Overheating due to increased resistance in a subcomponent or internal shorting	The lateral acceleration sensor may overheat due to increased resistance or other internal failures, resulting in an inaccurate measurement of the vehicle's lateral acceleration.
320	Sensor inadequate operation, change over time	Degradation over time	The lateral acceleration sensor may degrade over time, resulting in an inaccurate measurement of the vehicle's lateral acceleration.
321	Sensor inadequate operation, change over time	Reporting frequency too low	The lateral acceleration sensor reporting frequency may be too low, causing a delay in reporting the vehicle's lateral acceleration.
322	External disturbances	EMI or ESD	EMI or ESD from the external environment may affect the lateral acceleration sensor, resulting in an incorrect measurement of the vehicle's lateral acceleration.
323	External disturbances	Single event effects (e.g., cosmic rays, protons)	Single event effects may affect logic circuits in the lateral acceleration sensor, resulting in an incorrect measurement of the vehicle's lateral acceleration.
324	External disturbances	Vibration or shock impact	Vibration or shock impact from the external environment may damage or displace the lateral acceleration sensor or introduce signal noise, resulting in an incorrect measurement of the vehicle's lateral acceleration.
325	External disturbances	Manufacturing defects and assembly problems	Manufacturing defects or assembly problems may affect the lateral acceleration sensor, resulting in an incorrect measurement of the vehicle's lateral acceleration.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
326	External disturbances	Extreme external temperature or thermal cycling	Extreme external temperatures or thermal cycling may affect the accuracy of the lateral acceleration sensor, resulting in an incorrect measurement of the vehicle's lateral acceleration.
327	External disturbances	Moisture, corrosion, or contamination	Moisture, corrosion, or contamination from the external environment may damage the lateral acceleration sensor, resulting in an incorrect measurement of the vehicle's lateral acceleration.
328	External disturbances	Organic growth	Organic growth may damage the lateral acceleration sensor, resulting in an incorrect measurement of the vehicle's lateral acceleration.
329	External disturbances	Physical interference (e.g., chafing)	Physical interference from the external environment (e.g., road debris) may damage or displace the lateral acceleration sensor, resulting in an incorrect measurement of the vehicle's lateral acceleration.
330	Hazardous interaction with other components in the rest of the vehicle	EMI or ESD	EMI or ESD from other vehicle components may affect the lateral acceleration sensor, resulting in an incorrect measurement of the vehicle's lateral acceleration.
331	Hazardous interaction with other components in the rest of the vehicle	Vibration or shock impact	Vibration or shock impact from other vehicle components may damage or displace the lateral acceleration sensor or introduce signal noise, resulting in an incorrect measurement of the vehicle's lateral acceleration.
332	Hazardous interaction with other components in the rest of the vehicle	Excessive heat from other components	Excessive heat from other vehicle components may affect the accuracy of the lateral acceleration sensor, resulting in an incorrect measurement of the vehicle's lateral acceleration.
333	Hazardous interaction with other components in the rest of the vehicle	Moisture, corrosion, or contamination	Moisture, corrosion, or contamination from other vehicle components may damage the lateral acceleration sensor, resulting in an incorrect measurement of the vehicle's lateral acceleration.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
334	Hazardous interaction with other components in the rest of the vehicle	Physical interference (e.g., chafing)	Physical interference from other vehicle components may damage or displace the lateral acceleration sensor, resulting in an incorrect measurement of the vehicle's lateral acceleration.
335	Hazardous interaction with other components in the rest of the vehicle	Electrical arcing from neighboring components or exposed terminals	Electrical arcing from other vehicle components or exposed terminals may damage the lateral acceleration sensor, resulting in an incorrect measurement of the vehicle's lateral acceleration.
336	Power supply faulty (high, low, disturbance)	Loss of 12-volt power	Loss of the low voltage (12-volt) power supply may prevent the lateral acceleration sensor from measuring the vehicle's lateral acceleration.
337	Power supply faulty (high, low, disturbance)	Power supply faulty (high, low, disturbance)	A disturbance in the low voltage (12-volt) power supply may result in an incorrect measurement of the vehicle's lateral acceleration.

Table I-11: Master Cylinder/Hydraulic Reservoir

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
668	Controlled component failure, change over time	Internal hardware failure	The master cylinder or hydraulic reservoir may have an internal hardware failure, affecting the transmission of pressurized brake fluid through the brake/stability control system.
669	Controlled component failure, change over time	Degradation over time	The master cylinder or hydraulic reservoir may degrade over time, affecting the transmission of pressurized brake fluid through the brake/stability control system (e.g., loss of brake fluid pressure).
670	Input to controlled process missing or wrong	Input to controlled process missing or wrong	The brake fluid may be missing, low, or the incorrect type, affecting transmission of pressurized brake fluid throughout the brake/stability control system.
671	Output of controlled process contributes to system hazard	Output of controlled process contributes to system hazard	The master cylinder may output an incorrect brake fluid pressure.
672	External disturbances	Vibration or shock impact	Vibration or shock impact from the external environment may damage the master cylinder or hydraulic reservoir.
673	External disturbances	Manufacturing defects and assembly problems	Manufacturing defects or assembly problems may affect the master cylinder or hydraulic reservoir.
674	External disturbances	Extreme external temperature or thermal cycling	Extreme external temperatures or thermal cycling may affect the master cylinder or hydraulic reservoir.
675	External disturbances	Moisture, corrosion, or contamination	Moisture, corrosion, or contamination from the external environment may affect the master cylinder or hydraulic reservoir.
676	External disturbances	Physical interference (e.g., chafing)	Physical interference from the external environment (e.g., road debris) may affect the master cylinder or hydraulic reservoir.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
677	Hazardous interaction with other components in the rest of the vehicle	Vibration or shock impact	Vibration or shock impact from other vehicle components may affect the master cylinder or hydraulic reservoir.
678	Hazardous interaction with other components in the rest of the vehicle	Physical interference (e.g., chafing)	Physical interference from other vehicle components may affect the master cylinder or hydraulic reservoir.
679	Hazardous interaction with other components in the rest of the vehicle	Moisture, corrosion, or contamination	Moisture, corrosion, or contamination from other vehicle components may affect the master cylinder or hydraulic reservoir.

Table I-12: Steering System

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
338	Sensor inadequate operation, change over time	Internal hardware failure	Internal hardware failures may affect the steering wheel sensors (i.e., torque and angle sensors), resulting in the brake/stability control module incorrectly determining the driver's steering intent.
339	Sensor inadequate operation, change over time	Overheating due to increased resistance in a subcomponent or internal shorting	The steering wheel sensors (i.e., torque and angle sensors) may overheat due to increased resistance in a subcomponent or internal shorting, resulting in the brake/stability control module incorrectly determining the driver's steering intent.
340	Sensor inadequate operation, change over time	Degradation over time	The steering wheel sensors (i.e., torque and angle sensors) may degrade over time, affecting their accuracy and resulting in the brake/stability control module incorrectly determining the driver's steering intent.
341	Sensor inadequate operation, change over time	Reporting frequency too low	The reporting frequency for the steering wheel sensors (i.e., torque and angle sensors) may be too low, introducing a delay when the brake/stability control module determines the driver's steering intent.
342	External disturbances	EMI or ESD	EMI or ESD from the external environment may affect the steering wheel sensors (i.e., torque and angle sensors), resulting in the brake/stability control module incorrectly determining the driver's steering intent.
343	External disturbances	Single event effects (e.g., cosmic rays, protons)	Single event effects may affect logic circuits in the steering wheel sensors (i.e., torque and angle sensors), resulting in the brake/stability control module incorrectly determining the driver's steering intent.
344	External disturbances	Vibration or shock impact	Vibration or shock impact (e.g., road vibration) from the external environment may affect the steering wheel sensors (i.e., torque and angle sensors), resulting in the brake/stability control module incorrectly determining the driver's steering intent.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
345	External disturbances	Manufacturing defects and assembly problems	Manufacturing defects or assembly problems may affect the steering wheel sensors (i.e., torque and angle sensors), resulting in the brake/stability control module incorrectly determining the driver's steering intent.
346	External disturbances	Extreme external temperature or thermal cycling	Extreme external temperatures or thermal cycling may affect the steering wheel sensors (i.e., torque and angle sensors), resulting in the brake/stability control module incorrectly determining the driver's steering intent.
347	External disturbances	Moisture, corrosion, or contamination	Moisture, corrosion, or contamination from the external environment may damage the steering wheel sensors (i.e., torque and angle sensors), resulting in the brake/stability control module incorrectly determining the driver's steering intent.
348	External disturbances	Organic growth	Organic growth may damage the steering wheel sensors (i.e., torque and angle sensors), resulting in the brake/stability control module incorrectly determining the driver's steering intent.
349	External disturbances	Physical interference (e.g., chafing)	Physical interference from the external environment (e.g., road debris) may damage the steering wheel sensors (i.e., torque and angle sensors), resulting in the brake/stability control module incorrectly determining the driver's steering intent.
350	Sensor inadequate operation, change over time	Other	The steering wheel angle sensor may not correctly measure steering inputs greater than 360 degrees (e.g., the steering wheel may be able to rotate 720 degrees, but the steering wheel angle sensor may only detect rotation up to 360 degrees). This might affect how the brake/stability control module determines the driver's steering intent.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
351	External disturbances	Magnetic interference	Magnetic interference from the external environment may affect the steering wheel sensors (i.e., torque and angle sensors), resulting in the brake/stability control module incorrectly determining the driver's steering intent.
352	Hazardous interaction with other components in the rest of the vehicle	EMI or ESD	EMI or ESD from other vehicle components may affect the steering wheel sensors (i.e., torque and angle sensors), resulting in the brake/stability control module incorrectly determining the driver's steering intent.
353	Hazardous interaction with other components in the rest of the vehicle	Vibration or shock impact	Vibration or shock impact from other vehicle components may affect the steering wheel sensors (i.e., torque and angle sensors), resulting in the brake/stability control module incorrectly determining the driver's steering intent.
354	Hazardous interaction with other components in the rest of the vehicle	Excessive heat from other components	Excessive heat from other vehicle components may affect the steering wheel sensors (i.e., torque and angle sensors), resulting in the brake/stability control module incorrectly determining the driver's steering intent.
355	Hazardous interaction with other components in the rest of the vehicle	Moisture, corrosion, or contamination	Moisture, corrosion, or contamination from other vehicle components may damage the steering wheel sensors (i.e., torque and angle sensors), resulting in the brake/stability control module incorrectly determining the driver's steering intent.
356	Hazardous interaction with other components in the rest of the vehicle	Physical interference (e.g., chafing)	Physical interference from other vehicle components may damage the steering wheel sensors (i.e., torque and angle sensors), resulting in the brake/stability control module incorrectly determining the driver's steering intent.
357	Hazardous interaction with other components in the rest of the vehicle	Magnetic interference	Magnetic interference from other vehicle components may affect the steering wheel sensors (i.e., torque and angle sensors), resulting in the brake/stability control module incorrectly determining the driver's steering intent.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
358	Hazardous interaction with other components in the rest of the vehicle	Electrical arcing from neighboring components or exposed terminals	Electrical arcing from other vehicle components or exposed terminals may damage the steering wheel sensors (i.e., torque and angle sensors), resulting in the brake/stability control module incorrectly determining the driver's steering intent.
359	Power supply faulty (high, low, disturbance)	Loss of 12-volt power	If the steering wheel sensors (i.e., torque and angle sensors) lose the low voltage (12-volt) power supply, the brake/stability control module may not receive measurements of the driver's steering intent.
360	Power supply faulty (high, low, disturbance)	Power supply faulty (high, low, disturbance)	A disturbance in the low voltage (12-volt) power supply to the steering wheel sensors (i.e., torque and angle sensors) may cause the sensors to inaccurately measure the driver's steering input. This could affect the brake/stability control module's determination of the driver's steering intent.
361	Power supply faulty (high, low, disturbance)	Reference voltage incorrect (e.g., too low, too high)	A disturbance in the reference voltage supplied to the steering wheel sensors (i.e., torque and angle sensors) may cause an offset in the measurement. This could affect the brake/stability control module's determination of the driver's steering intent.

Table I-13: Wheel Speed Sensor

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
34	Sensor inadequate operation, change over time	Internal hardware failure	The wheel speed sensor may have an internal hardware failure (e.g., an internal short), affecting its ability to accurately measure the wheel speed.
35	Sensor inadequate operation, change over time	Degradation over time	The wheel speed sensor may degrade over time (e.g., rust build-up on the tone wheel), affecting its ability to accurately measure the wheel speed.
36	Sensor inadequate operation, change over time	Reporting frequency too low	The wheel speed sensor reporting frequency to the brake/stability control module may be too low, causing a delay in updating the wheel speed data.
37	External disturbances	EMI or ESD	EMI or ESD from the external environment may affect the wheel speed sensor measurement.
38	External disturbances	Vibration or shock impact	Vibration or shock impact may affect the wheel speed sensor (e.g., affecting the positioning of the sensor relative to the tone wheel).
39	External disturbances	Manufacturing defects and assembly problems	Manufacturing defects or assembly problems may affect the wheel speed sensor (e.g., incorrect air gap), affecting its ability to correctly measure the wheel speed.
40	External disturbances	Extreme external temperature or thermal cycling	Extreme external temperature or thermal cycling may affect the wheel speed sensor measurements.
41	External disturbances	Moisture, corrosion, or contamination	Moisture, corrosion, or contamination may affect the wheel speed sensor (e.g., causing premature degradation of electronic subcomponents).
42	External disturbances	Physical interference (e.g., chafing)	Physical interference with other vehicle components may affect the wheel speed sensor (e.g., disrupting the spacing between the reader and the tone wheel).

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
43	External disturbances	Magnetic interference	Magnetic interference from the external environment may affect the ability for the wheel speed sensor to properly detect the tone wheel position.
44	Power supply faulty (high, low, disturbance)	Loss of 12-volt power	If the wheel speed sensor requires low voltage power to operate (e.g., an active wheel speed sensor), loss of low voltage power may prevent measurement of the wheel speed.
45	Power supply faulty (high, low, disturbance)	Power supply faulty (high, low, disturbance)	If the wheel speed sensor requires low voltage power to operate (e.g., an active wheel speed sensor), a disturbance in the power supply may affect the accuracy of the wheel speed measurement.
46	Hazardous interaction with other components in the rest of the vehicle	EMI or ESD	EMI or ESD from other vehicle components may affect the ability for the wheel speed sensor to accurately measure the wheel speed.
47	Hazardous interaction with other components in the rest of the vehicle	Vibration or shock impact	Vibration or shock impact from other vehicle components may affect the positioning between the wheel speed sensor and tone wheel, affecting the accuracy of the wheel speed measurement.
49	Hazardous interaction with other components in the rest of the vehicle	Physical interference (e.g., chafing)	Physical interference from other vehicle components may affect the positioning between the wheel speed sensor and tone wheel, affecting the accuracy of the wheel speed measurement.
50	Hazardous interaction with other components in the rest of the vehicle	Moisture, corrosion, or contamination	Moisture, corrosion, or contamination from other vehicle components may affect the wheel speed sensor (e.g., internal shorting or premature degradation of electronic subcomponents).
51	Hazardous interaction with other components in the rest of the vehicle	Excessive heat from other components	Excessive heat from other vehicle components may affect the wheel speed sensor.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
52	External disturbances	Single event effects (e.g., cosmic rays, protons)	If the wheel speed sensor is an active sensor (i.e., has an integrated circuit), single event effects may affect the circuit logic, resulting in an incorrect wheel speed measurement.
53	External disturbances	Organic growth	If the wheel speed sensor is an active sensor (i.e., has an integrated circuit), organic growth may cause internal shorting or otherwise affect the proper functioning of the wheel speed sensor circuit.
54	Hazardous interaction with other components in the rest of the vehicle	Magnetic interference	Magnetic interference from other vehicle components may affect the wheel speed sensor.
55	Hazardous interaction with other components in the rest of the vehicle	Electrical arcing from neighboring components or exposed terminals	Electrical arcing from neighboring components or exposed terminals may affect the wheel speed sensor.

Table I-14: Yaw Rate Sensor

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
362	Sensor inadequate operation, change over time	Internal hardware failure	An internal hardware failure may affect the yaw rate sensor, resulting in an incorrect measurement of the vehicle's yaw rate.
363	Sensor inadequate operation, change over time	Overheating due to increased resistance in a subcomponent or internal shorting	The yaw rate sensor may overheat due to increased resistance in a subcomponent or internal shorting, affecting its ability to measure the vehicle's yaw rate.
364	Sensor inadequate operation, change over time	Degradation over time	The yaw rate sensor may degrade over time, affecting its ability to accurately measure the vehicle's yaw rate.
365	Sensor inadequate operation, change over time	Reporting frequency too low	The reporting frequency for the yaw rate sensor may be too low, introducing a delay in reporting the yaw rate to the brake/stability control module.
366	External disturbances	EMI or ESD	EMI or ESD from the external environment may affect the yaw rate sensor, resulting in an incorrect measurement of the vehicle's yaw rate.
367	External disturbances	Single event effects (e.g., cosmic rays, protons)	Single event effects may affect logic circuits in the yaw rate sensor, resulting in an incorrect measurement of the vehicle's yaw rate.
368	External disturbances	Vibration or shock impact	Vibration or shock impact from the external environment (e.g., bumpy roads) may damage or displace the yaw rate sensor, or affect the accuracy of its measurement of the vehicle's yaw rate.
369	External disturbances	Manufacturing defects and assembly problems	Manufacturing defects or assembly problems may affect the accuracy the yaw rate sensor's measurement of the vehicle's yaw rate.
370	External disturbances	Extreme external temperature or thermal cycling	Extreme external temperatures or thermal cycling may affect the yaw rate sensor, resulting in an incorrect measurement of the vehicle's yaw rate.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
371	External disturbances	Moisture, corrosion, or contamination	Moisture, corrosion, or contamination from the external environment may damage the yaw rate sensor, resulting in an incorrect measurement of the vehicle's yaw rate.
372	External disturbances	Organic growth	Organic growth may damage the yaw rate sensor, resulting in an incorrect measurement of the vehicle's yaw rate.
373	External disturbances	Physical interference (e.g., chafing)	Physical interference from the external environment may damage the yaw rate sensor, resulting in an incorrect measurement of the vehicle's yaw rate.
374	External disturbances	Magnetic interference	Magnetic interference from the external environment may affect the yaw rate sensor (e.g., creating an offset), resulting in an incorrect measurement of the vehicle's yaw rate.
375	Hazardous interaction with other components in the rest of the vehicle	EMI or ESD	EMI or ESD from other vehicle components may affect the yaw rate sensor, resulting in an incorrect measurement of the vehicle's yaw rate.
376	Hazardous interaction with other components in the rest of the vehicle	Vibration or shock impact	Vibration or shock impact from other vehicle components may damage or displace the yaw rate sensor, or affect the accuracy of its measurement of the vehicle's yaw rate.
377	Hazardous interaction with other components in the rest of the vehicle	Excessive heat from other components	Excessive heat from other vehicle components may affect the yaw rate sensor, resulting in an incorrect measurement of the vehicle's yaw rate.
378	Hazardous interaction with other components in the rest of the vehicle	Moisture, corrosion, or contamination	Moisture, corrosion, or contamination from other vehicle components may damage the yaw rate sensor, resulting in an incorrect measurement of the vehicle's yaw rate.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
379	Hazardous interaction with other components in the rest of the vehicle	Physical interference (e.g., chafing)	Physical interference from other vehicle components may damage the yaw rate sensor, resulting in an incorrect measurement of the vehicle's yaw rate.
380	Hazardous interaction with other components in the rest of the vehicle	Magnetic interference	Magnetic interference from other vehicle components may affect the yaw rate sensor (e.g., creating an offset), resulting in an incorrect measurement of the vehicle's yaw rate.
381	Hazardous interaction with other components in the rest of the vehicle	Electrical arcing from neighboring components or exposed terminals	Electrical arcing from other vehicle components or exposed terminals may damage the yaw rate sensor, resulting in an incorrect measurement of the vehicle's yaw rate.
382	Power supply faulty (high, low, disturbance)	Loss of 12-volt power	The yaw rate sensor may lose the low voltage (12-volt) power supply, affecting its ability to measure the vehicle's yaw rate.
383	Power supply faulty (high, low, disturbance)	Loss of 12-volt power	A disturbance in the low voltage (12-volt) power supply may damage or disrupt the yaw rate sensor, affecting its ability to accurately measure the vehicle's yaw rate.
383	Power supply faulty (high, low, disturbance)	Power supply faulty (high, low, disturbance)	A disturbance in the low voltage (12-volt) power supply may damage or disrupt the yaw rate sensor, affecting its ability to accurately measure the vehicle's yaw rate.

Table I-15: Brake Booster to Master Cylinder/Hydraulic Reservoir

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
689	Actuation delivered incorrectly or inadequately: Hardware faulty	Actuation delivered incorrectly or inadequately: Hardware faulty	A hardware failure may affect movement of the pushrod connecting the brake booster and master cylinder.
690	External disturbances	Vibration or shock impact	Vibration or shock impact from the external environment could affect the connection between the brake booster and master cylinder.
691	External disturbances	Manufacturing defects and assembly problems	Manufacturing defects or assembly problems could affect the connection between the brake booster and master cylinder.
692	External disturbances	Extreme external temperature or thermal cycling	Extreme external temperatures or thermal cycling could affect the connection between the brake booster and master cylinder.
693	External disturbances	Physical interference (e.g., chafing)	Physical interference from the external environment could affect the connection between the brake booster and master cylinder.
694	External disturbances	Mechanical connections affected by moisture, corrosion, or contamination	Moisture, corrosion, or contamination from the external environment could affect the connection between the brake booster and master cylinder.
695	Hazardous interaction with other components in the rest of the vehicle	Vibration or shock impact	Vibration or shock impact from other vehicle components could affect the connection between the brake booster and master cylinder.
696	Hazardous interaction with other components in the rest of the vehicle	Physical interference (e.g., chafing)	Physical interference from other vehicle components could affect the connection between the brake booster and master cylinder.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
697	Hazardous interaction with other components in the rest of the vehicle	Excessive heat from other components	Excessive heat from other vehicle components could affect the connection between the brake booster and master cylinder.
698	Hazardous interaction with other components in the rest of the vehicle	Mechanical connections affected by moisture, corrosion, or contamination	Moisture, corrosion, or contamination from other vehicle components could affect the connection between the brake booster and master cylinder.

Table I-16: Brake Modulator to Brake Pads/Drum Assembly

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
150	Actuation delivered incorrectly or inadequately: Hardware faulty	Actuation delivered incorrectly or inadequately: Hardware faulty	The brake hose connecting the brake modulator and brake pads/drum assembly may be faulty (e.g., damaged or leaking). This could affect the pressure of the brake fluid delivered to the brake pads/drum assembly.
151	Actuation delivered incorrectly or inadequately: Actuation delayed	Actuation delivered incorrectly or inadequately: Actuation delayed	A failure in the brake hose connecting the brake modulator to the brake pads/drum assembly (e.g., a pin-hole leak or air in the brake lines) may cause a delay in pressure accumulation at the brake pads/drum assembly.
152	Actuation delivered incorrectly or inadequately: Incorrect connection	Actuation delivered incorrectly or inadequately: Incorrect connection	The brake modulator and brake pads/drum assembly may be incorrectly connected (e.g., L/R or F/R hoses may be reversed). This could affect the ability of the brake/stability control module to brake the correct wheel.
153	External disturbances	Vibration or shock impact	Vibration or shock impact from the external environment could affect the brake hose connection between the brake modulator and the brake pads/drum assembly (e.g., cause the hose to come loose).
154	External disturbances	Manufacturing defects and assembly problems	Manufacturing defects or assembly problems may affect the connection between the brake modulator and brake pads/drum assembly.
155	External disturbances	Physical interference (e.g., chafing)	Physical interference from the external environment (e.g., road debris) may affect the connection between the brake modulator and brake pads/drum assembly (e.g., damage the brake line).
156	External disturbances	Mechanical connections affected by moisture, corrosion, or contamination	Moisture, corrosion, or contamination from the external environment may affect the brake line connecting the brake modulator and brake pads/drum assembly (e.g., salt corrosion).

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
157	Hazardous interaction with other components in the rest of the vehicle	Mechanical connections affected by moisture, corrosion, or contamination	Moisture, corrosion, or contamination from other vehicle components may affect the brake line connecting the brake modulator and brake pads/drum assembly.
158	Hazardous interaction with other components in the rest of the vehicle	Vibration or shock impact	Vibration or shock impact from other vehicle components could affect the brake hose connection between the brake modulator and the brake pads/drum assembly (e.g., cause the hose to come loose).
159	Hazardous interaction with other components in the rest of the vehicle	Physical interference (e.g., chafing)	Physical interference from other vehicle components may affect the connection between the brake modulator and brake pads/drum assembly (e.g., damage the brake line).
160	Hazardous interaction with other components in the rest of the vehicle	Excessive heat from other components	Excessive heat from other vehicle components may heat up the brake fluid as it's transmitted between the brake modulator and brake pads/drum assembly.
748	Actuation delivered incorrectly or inadequately: Hardware faulty	Other	One of the brake circuits may be disabled, affecting the ability to control brake pressure to certain wheels or the ability to provide sufficient braking force.

Table I-17: Brake Pedal Mechanical Assembly to Brake Booster

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
680	Actuation delivered incorrectly or inadequately: Hardware faulty	Actuation delivered incorrectly or inadequately: Hardware faulty	A hardware failure may affect the mechanical link between the brake pedal mechanical assembly and brake booster.
681	External disturbances	Vibration or shock impact	Vibration or shock impact from the external environment may affect the connection between the brake pedal mechanical assembly and brake booster (e.g., cause misalignment).
682	External disturbances	Manufacturing defects and assembly problems	Manufacturing defects or assembly problems may affect the connection between the brake pedal mechanical assembly and brake booster.
683	External disturbances	Extreme external temperature or thermal cycling	Extreme external temperature or thermal cycling may affect the connection between the brake pedal mechanical assembly and brake booster.
684	External disturbances	Physical interference (e.g., chafing)	Physical interference from the external environment may affect the connection between the brake pedal mechanical assembly and brake booster (e.g., trapping the rod).
685	External disturbances	Mechanical connections affected by moisture, corrosion, or contamination	Moisture, corrosion, or contamination from the external environment may affect the connection between the brake pedal mechanical assembly and brake booster (e.g., debris entering the air intake).
686	Hazardous interaction with other components in the rest of the vehicle	Vibration or shock impact	Vibration or shock impact from other vehicle components may affect the connection between the brake pedal mechanical assembly and brake booster.
687	Hazardous interaction with other components in the rest of the vehicle	Physical interference (e.g., chafing)	Physical interference from other vehicle components may affect the connection between the brake pedal mechanical assembly and brake booster.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
688	Hazardous interaction with other components in the rest of the vehicle	Mechanical connections affected by moisture, corrosion, or contamination	Moisture, corrosion, or contamination from other vehicle components may affect the connection between the brake pedal mechanical assembly and brake booster.

Table I-18: Brake Pedal Mechanical Assembly to Brake Pedal Position Sensor

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
735	Sensor measurement incorrect or missing	Sensor incorrectly aligned or positioned	The brake pedal position sensor may be incorrectly aligned or positioned relative to the brake pedal, resulting in a missing measurement or a measurement that is out of range.
736	Sensor measurement inaccurate	Sensor incorrectly aligned or positioned	The brake pedal position sensor may be incorrectly aligned or positioned relative to the brake pedal, resulting in an incorrect measurement (but within range).
737	Sensor measurement delay	Sensor incorrectly aligned or positioned	The brake pedal position sensor may be incorrectly aligned or positioned relative to the brake pedal, resulting in a delay when measuring the brake pedal position.
738	External disturbances	Vibration or shock impact	Vibration or shock impact from the external environment may affect the alignment of the brake pedal position sensor with the brake pedal mechanical assembly, resulting in an incorrect measurement of the brake pedal position.
739	External disturbances	Manufacturing defects and assembly problems	Manufacturing defects or assembly problems may affect the alignment of the brake pedal position sensor with the brake pedal mechanical assembly, resulting in an incorrect measurement of the brake pedal position.
740	External disturbances	Extreme external temperature or thermal cycling	Extreme external temperature or thermal cycling may affect the interface of the brake pedal position sensor with the brake pedal mechanical assembly, resulting in an incorrect measurement of the brake pedal position.
741	External disturbances	Physical interference (e.g., chafing)	Physical interference from the external environment (e.g., objects in the driver's footwell) may affect the interface of the brake pedal position sensor with the brake pedal mechanical assembly, resulting in an incorrect measurement of the brake pedal position.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
742	External disturbances	Mechanical connections affected by moisture, corrosion, or contamination	Moisture, corrosion, or contamination from the external environment may affect the interface of the brake pedal position sensor with the brake pedal mechanical assembly, resulting in an incorrect measurement of the brake pedal position.
743	Hazardous interaction with other components in the rest of the vehicle	Vibration or shock impact	Vibration or shock impact from other vehicle components may affect the alignment of the brake pedal position sensor with the brake pedal mechanical assembly, resulting in an incorrect measurement of the brake pedal position.
744	Hazardous interaction with other components in the rest of the vehicle	Physical interference (e.g., chafing)	Physical interference from other vehicle components may affect the alignment of the brake pedal position sensor with the brake pedal mechanical assembly, resulting in an incorrect measurement of the brake pedal position.
745	Hazardous interaction with other components in the rest of the vehicle	Excessive heat from other components	Excessive heat from other vehicle components may affect the interface of the brake pedal position sensor with the brake pedal mechanical assembly, resulting in an incorrect measurement of the brake pedal position.
746	Hazardous interaction with other components in the rest of the vehicle	Mechanical connections affected by moisture, corrosion, or contamination	Moisture, corrosion, or contamination from other vehicle components may affect the interface of the brake pedal position sensor with the brake pedal mechanical assembly, resulting in an incorrect measurement of the brake pedal position.

Table I-19: Brake Pedal Position Sensor to CHB Control Module

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
197	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connection is intermittent	An intermittent connection between the brake pedal position sensor and the brake/stability control module may result in the brake/stability control module receiving an intermittent brake pedal position measurement.
198	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connection is open, short to ground, short to battery, or short to other wires in harness	The connection between the brake pedal position sensor and the brake/stability control module may develop an open circuit or short circuit (e.g., to ground, battery, or other wires), resulting in the brake/stability control module receiving an incorrect brake pedal position measurement.
199	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Electrical noise other than EMI or ESD	Electrical noise, other than EMI or ESD, may affect the connection between the brake pedal position sensor and the brake/stability control module, resulting in the brake/stability control module receiving an incorrect brake pedal position measurement.
200	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connector contact resistance is too high	The contact resistance in the connectors for the brake pedal position sensor or the brake/stability control module may be too high, resulting in the brake/stability control module receiving an incorrect brake pedal position measurement.
201	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connector shorting between neighboring pins	Shorting may occur between pins in the connectors for the brake pedal position sensor or the brake/stability control module, resulting in the brake/stability control module receiving an incorrect brake pedal position measurement.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
202	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connector resistive drift between neighboring pins	Resistive drift may occur between pins in the connectors for the brake pedal position sensor or the brake/stability control module, resulting in the brake/stability control module receiving an incorrect brake pedal position measurement.
203	Sensor to controller signal inadequate, missing, or delayed: Communication bus error	Bus overload or bus error	If the signal from the brake pedal position sensor to the brake/stability control module is transmitted over the communication bus, a bus overload or bus error may prevent the brake/stability control module from receiving the brake pedal position measurement.
204	Sensor to controller signal inadequate, missing, or delayed: Communication bus error	Signal priority too low	If the signal from the brake pedal position sensor to the brake/stability control module is transmitted over the communication bus, the brake pedal position sensor signal priority may be too low, preventing or delaying transmission of the brake pedal position to the brake/stability control module.
205	Sensor to controller signal inadequate, missing, or delayed: Communication bus error	Failure of the message generator, transmitter, or receiver	If the signal from the brake pedal position sensor to the brake/stability control module is transmitted over the communication bus, failure of the message generator, transmitter, or receiver may result in incorrect data or failure to transmit data.
206	Sensor to controller signal inadequate, missing, or delayed: Communication bus error	Malicious Intruder	If the signal from the brake pedal position sensor to the brake/stability control module is transmitted over the communication bus, a malicious intruder or aftermarket component may write a signal to the communication bus that mimics the brake pedal position sensor signal.
207	Sensor to controller signal inadequate, missing, or delayed: Incorrect connection	Incorrect wiring connection	The connection between the brake pedal position sensor and brake/stability control module may be incorrectly wired (e.g., reversed wiring), resulting in the brake/stability control module receiving an incorrect brake pedal position measurement.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
208	Sensor to controller signal inadequate, missing, or delayed: Incorrect connection	Incorrect pin assignment	The connection between the brake pedal position sensor and brake/stability control module may have an incorrect pin assignment, resulting in the brake/stability control module receiving an incorrect brake pedal position measurement.
209	External disturbances	EMI or ESD	EMI or ESD from the external environment may affect the signal from the brake pedal position sensor to the brake/stability control module, resulting in the brake/stability control module receiving incorrect data.
210	External disturbances	Vibration or shock impact	Vibration or shock impact from the external environment may affect the connection between the brake pedal position sensor to the brake/stability control module (e.g., fretting or loose wiring), resulting in the brake/stability control module receiving incorrect data.
211	External disturbances	Manufacturing defects and assembly problems	Manufacturing defects or assembly problems may affect the connection between the brake pedal position sensor and the brake/stability control module, resulting in the brake/stability control module receiving incorrect data.
212	External disturbances	Extreme external temperature or thermal cycling	Extreme external temperature or thermal cycling may affect transmission of data from the brake pedal position sensor to the brake/stability control module (e.g., damage to wiring insulation or change in resistive properties).
213	External disturbances	Unused connection terminals affected by moisture, corrosion, or contamination	Unused connection terminals in the wiring harness connecting the brake pedal position sensor and brake/stability control module may be affected by moisture, corrosion, or contamination from the external environment (e.g., causing shorting between pins).
214	External disturbances	Organic growth	Organic growth in the connection terminals of the brake pedal position sensor or brake/stability control module may result in shorting between pins.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
215	External disturbances	Physical interference (e.g., chafing)	Physical interference from the external environment (e.g., road debris) may affect the connection between the brake pedal position sensor and brake/stability control module (e.g., damaging wiring).
216	External disturbances	Active connection terminals affected by moisture, corrosion, or contamination	Moisture, corrosion, or contamination from the external environment may affect the active connection terminals of the brake pedal position sensor or brake/stability control module.
217	Hazardous interaction with other components in the rest of the vehicle	EMI or ESD	EMI or ESD from other vehicle components may affect the signal from the brake pedal position sensor to the brake/stability control module, resulting in the brake/stability control module receiving incorrect data.
218	Hazardous interaction with other components in the rest of the vehicle	Vibration or shock impact	Vibration or shock impact from other vehicle components may affect the connection between the brake pedal position sensor to the brake/stability control module (e.g., fretting or loose wiring), resulting in the brake/stability control module receiving incorrect data.
219	Hazardous interaction with other components in the rest of the vehicle	Excessive heat from other components	Excessive heat from other vehicle components may affect the connection between the brake pedal position sensor to the brake/stability control module (e.g., damage to wiring insulation or change in resistive properties).
220	Hazardous interaction with other components in the rest of the vehicle	Unused connection terminals affected by moisture, corrosion, or contamination	Unused connection terminals in the wiring harness connecting the brake pedal position sensor and brake/stability control module may be affected by moisture, corrosion, or contamination from other vehicle components (e.g., causing shorting between pins).
221	Hazardous interaction with other components in the rest of the vehicle	Physical interference (e.g., chafing)	Physical interference from other vehicle components may affect the connection between the brake pedal position sensor and brake/stability control module (e.g., damaging wiring).

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
222	Hazardous interaction with other components in the rest of the vehicle	Active connection terminals affected by moisture, corrosion, or contamination	Moisture, corrosion, or contamination from other vehicle components may affect the active connection terminals of the brake pedal position sensor or brake/stability control module.
223	Hazardous interaction with other components in the rest of the vehicle	Electrical arcing from neighboring components or exposed terminals	Electrical arcing from neighboring components or exposed terminals may affect the connection between the brake pedal position sensor and brake/stability control module.

Table I-20: Brake Pressure Sensor to CHB Control Module

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
384	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connection is intermittent	An intermittent connection between the brake pressure sensor and brake/stability control module may affect the signal, causing the brake/stability control module to misinterpret the driver's intent (e.g., hard braking).
385	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connection is open, short to ground, short to battery, or short to other wires in harness	If the connection between the brake pressure sensor and brake/stability control module is open or shorted (e.g., to ground, battery, or other wires), this may affect the signal causing the brake/stability control module to misinterpret the driver's intent (e.g., hard braking).
386	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Electrical noise other than EMI or ESD	Electrical noise, other than EMI or ESD, may affect connection between the brake pressure sensor and brake/stability control module. This may affect the signal causing the brake/stability control module to misinterpret the driver's intent (e.g., hard braking).
387	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connector contact resistance is too high	The contact resistance in the connectors for the brake pressure sensor or brake/stability control module may be too high. This may affect the signal causing the brake/stability control module to misinterpret the driver's intent (e.g., hard braking).
388	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connector shorting between neighboring pins	Shorting may occur between neighboring pins in the connectors for the brake pressure sensor or brake/stability control module. This may affect the signal causing the brake/stability control module to misinterpret the driver's intent (e.g., hard braking).

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
389	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connector resistive drift between neighboring pins	Resistive drift may occur between neighboring pins in the connectors for the brake pressure sensor or brake/stability control module. This may affect the signal causing the brake/stability control module to misinterpret the driver's intent (e.g., hard braking).
390	Sensor to controller signal inadequate, missing, or delayed: Communication bus error	Bus overload or bus error	If the signal from the brake pressure sensor to the brake/stability control module is transmitted over the communication bus, a bus overload or bus error may affect transmission of the brake pressure data. This may affect the signal causing the brake/stability control module to misinterpret the driver's intent (e.g., hard braking).
391	Sensor to controller signal inadequate, missing, or delayed: Communication bus error	Signal priority too low	If the signal from the brake pressure sensor to the brake/stability control module is transmitted over the communication bus, the brake pressure sensor signal priority may be too low. This may introduce a delay when the brake/stability control module tries to determine the driver's intent (e.g., hard braking).
392	Sensor to controller signal inadequate, missing, or delayed: Communication bus error	Failure of the message generator, transmitter, or receiver	If the signal from the brake pressure sensor to the brake/stability control module is transmitted over the communication bus, failure of the message generator, transmitter, or receiver may affect transmission of the brake pressure data. This may affect the signal causing the brake/stability control module to misinterpret the driver's intent (e.g., hard braking).
393	Sensor to controller signal inadequate, missing, or delayed: Communication bus error	Malicious Intruder	If the signal from the brake pressure sensor to the brake/stability control module is transmitted over the communication bus, a malicious intruder or aftermarket component may affect transmission of the brake pressure data. This may affect the signal causing the brake/stability control module to misinterpret the driver's intent (e.g., hard braking).

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
394	Sensor to controller signal inadequate, missing, or delayed: Incorrect connection	Incorrect wiring connection	The wiring harness connecting the brake pressure sensor and brake/stability control module may have an incorrect wiring connection. This may affect the signal causing the brake/stability control module to misinterpret the driver's intent (e.g., hard braking).
395	Sensor to controller signal inadequate, missing, or delayed: Incorrect connection	Incorrect pin assignment	The wiring harness connecting the brake pressure sensor and brake/stability control module may have an incorrect pin assignment. This may cause the brake/stability control module to misinterpret the driver's intent (e.g., hard braking).
396	External disturbances	EMI or ESD	EMI or ESD from the external environment may affect the signal from the brake pressure sensor to the brake/stability control module. This may cause the brake/stability control module to misinterpret the driver's intent (e.g., hard braking).
397	External disturbances	Vibration or shock impact	Vibration or shock impact from the external environment may affect the connection between the brake pressure sensor and the brake/stability control module (e.g., fretting). This may cause the brake/stability control module to misinterpret the driver's intent (e.g., hard braking).
398	External disturbances	Manufacturing defects and assembly problems	Manufacturing defects or assembly problems may affect the connection between the brake pressure sensor and the brake/stability control module. This may cause the brake/stability control module to misinterpret the driver's intent (e.g., hard braking).
399	External disturbances	Extreme external temperature or thermal cycling	Extreme external temperatures or thermal cycling may affect the connection between the brake pressure sensor and the brake/stability control module (e.g., degrade the wiring). This may cause the brake/stability control module to misinterpret the driver's intent (e.g., hard braking).

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
400	External disturbances	Unused connection terminals affected by moisture, corrosion, or contamination	Unused connection terminals in the wiring harness connecting the brake pressure sensor and brake/stability control module may be affected by moisture, corrosion, or contamination from the external environment (e.g., causing shorting between pins). This may cause the brake/stability control module to misinterpret the driver's intent (e.g., hard braking).
401	External disturbances	Organic growth	Organic growth may affect the connection terminals of the brake pressure sensor or brake/stability control module (e.g., causing shorting between pins). This may cause the brake/stability control module to misinterpret the driver's intent (e.g., hard braking).
402	External disturbances	Physical interference (e.g., chafing)	Physical interference from the external environment may affect the connection between the brake pressure sensor and brake/stability control module. This may cause the brake/stability control module to misinterpret the driver's intent (e.g., hard braking).
403	External disturbances	Active connection terminals affected by moisture, corrosion, or contamination	Moisture, corrosion, or contamination from the external environment may affect the connection between the brake pressure sensor and the brake/stability control module. This may cause the brake/stability control module to misinterpret the driver's intent (e.g., hard braking).
404	Hazardous interaction with other components in the rest of the vehicle	EMI or ESD	EMI or ESD from other vehicle components may affect the signal from the brake pressure sensor to the brake/stability control module. This may cause the brake/stability control module to misinterpret the driver's intent (e.g., hard braking).
405	Hazardous interaction with other components in the rest of the vehicle	Vibration or shock impact	Vibration or shock impact from other vehicle components may affect the connection between the brake pressure sensor and the brake/stability control module (e.g., fretting). This may cause the brake/stability control module to misinterpret the driver's intent (e.g., hard braking).

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
406	Hazardous interaction with other components in the rest of the vehicle	Excessive heat from other components	Excessive heat from other vehicle components may affect the connection between the brake pressure sensor and the brake/stability control module (e.g., melt the wiring). This may cause the brake/stability control module to misinterpret the driver's intent (e.g., hard braking).
407	Hazardous interaction with other components in the rest of the vehicle	Unused connection terminals affected by moisture, corrosion, or contamination	Unused connection terminals in the wiring harness connecting the brake pressure sensor and brake/stability control module may be affected by moisture, corrosion, or contamination from other vehicle components (e.g., causing shorting between pins). This may cause the brake/stability control module to misinterpret the driver's intent (e.g., hard braking).
408	Hazardous interaction with other components in the rest of the vehicle	Physical interference (e.g., chafing)	Physical interference from other vehicle components may affect the connection between the brake pressure sensor and brake/stability control module. This may cause the brake/stability control module to misinterpret the driver's intent (e.g., hard braking).
409	Hazardous interaction with other components in the rest of the vehicle	Active connection terminals affected by moisture, corrosion, or contamination	Moisture, corrosion, or contamination from other vehicle components may affect the connection between the brake pressure sensor and the brake/stability control module. This may cause the brake/stability control module to misinterpret the driver's intent (e.g., hard braking).
410	Hazardous interaction with other components in the rest of the vehicle	Electrical arcing from neighboring components or exposed terminals	Electrical arcing from other vehicle components or exposed terminals may affect the connection between the brake pressure sensor and the brake/stability control module. This may cause the brake/stability control module to misinterpret the driver's intent (e.g., hard braking).

Table I-21: CHB Control Module to ACS/ETC System

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
240	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connection is intermittent	An intermittent connection between the brake/stability control module and the ACS/ETC control module may affect transmission of the vehicle speed data.
241	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connection is open, short to ground, short to battery, or short to other wires in harness	If the connection between the brake/stability control module and the ACS/ETC control module is open or shorted (e.g., to ground, battery, or other wires), this may affect transmission of the vehicle speed data.
242	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Electrical noise other than EMI or ESD	Electrical noise, other than EMI or ESD, may corrupt the vehicle speed data as it's transmitted from the brake/stability control module to the ACS/ETC control module.
243	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connector contact resistance is too high	The contact resistance in the connectors for the brake/stability control module or ACS/ETC control module may be too high, affecting the vehicle speed data.
244	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connector shorting between neighboring pins	Shorting between neighboring pins in the connectors for the brake/stability control module or ACS/ETC control module may affect the vehicle speed data.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
245	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connector resistive drift between neighboring pins	Resistive drift between neighboring pins in the connectors for the brake/stability control module or ACS/ETC control module may affect the vehicle speed data.
247	Sensor to controller signal inadequate, missing, or delayed: Communication bus error	Bus overload or bus error	If the vehicle speed data is transmitted via the communication bus, a bus overload or bus error may prevent the vehicle speed data from being written to the bus.
248	Sensor to controller signal inadequate, missing, or delayed: Communication bus error	Signal priority too low	If the vehicle speed data is transmitted via the communication bus, the vehicle speed signal priority may be too low.
249	Sensor to controller signal inadequate, missing, or delayed: Communication bus error	Failure of the message generator, transmitter, or receiver	If the vehicle speed data is transmitted via the communication bus, failure of the message generator, transmitter, or receiver may prevent the vehicle speed data from being written to the bus.
250	Sensor to controller signal inadequate, missing, or delayed: Communication bus error	Malicious Intruder	If the vehicle speed data is transmitted via the communication bus, a malicious intruder or aftermarket component may write a message to the communication bus that mimics the vehicle speed signal.
251	Sensor to controller signal inadequate, missing, or delayed: Incorrect connection	Incorrect wiring connection	The connection between the brake/stability control module and ACS/ETC control module may be incorrectly wired, affecting the vehicle speed data.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
252	Sensor to controller signal inadequate, missing, or delayed: Incorrect connection	Incorrect pin assignment	The connection between the brake/stability control module and ACS/ETC control module may have an incorrect pin assignment, affecting the vehicle speed data.
253	External disturbances	EMI or ESD	EMI or ESD from the external environment may affect the connection between the brake/stability control and the ACS/ETC control module.
254	External disturbances	Vibration or shock impact	Vibration or shock impact from the external environment may affect the connection between the brake/stability control and the ACS/ETC control module (e.g., fretting or a connection becomes loose).
255	External disturbances	Manufacturing defects and assembly problems	Manufacturing defects or assembly problems may affect the connection between the brake/stability control module and the ACS/ETC control module.
256	External disturbances	Unused connection terminals affected by moisture, corrosion, or contamination	Unused connection terminals in the wiring harness connecting the brake/stability control module and ACS/ETC control module may be affected by moisture, corrosion, or contamination from the external environment (e.g., causing shorting between pins).
257	External disturbances	Extreme external temperature or thermal cycling	Extreme external temperature or thermal cycling may affect the connection between the brake/stability control module and ACS/ETC control module (e.g., degradation of wiring insulation).
258	External disturbances	Organic growth	Organic growth may affect the connection terminals of the brake/stability control module or ACS/ETC control module (e.g., causing shorting between pins).
259	External disturbances	Physical interference (e.g., chafing)	Physical interference from the external environment (e.g., road debris) may affect the connection between the brake/stability control module and ACS/ETC control module (e.g., damage to wiring).

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
260	External disturbances	Active connection terminals affected by moisture, corrosion, or contamination	Moisture, corrosion, or contamination from the external environment may affect the active connection terminals of the brake/stability control module or ACS/ETC control module.
261	Hazardous interaction with other components in the rest of the vehicle	EMI or ESD	EMI or ESD from other vehicle components may affect the connection between the brake/stability control and the ACS/ETC control module.
262	Hazardous interaction with other components in the rest of the vehicle	Vibration or shock impact	Vibration or shock impact from other vehicle components may affect the connection between the brake/stability control and the ACS/ETC control module (e.g., fretting or a connection becomes loose).
263	Hazardous interaction with other components in the rest of the vehicle	Unused connection terminals affected by moisture, corrosion, or contamination	Unused connection terminals in the wiring harness connecting the brake/stability control module and ACS/ETC control module may be affected by moisture, corrosion, or contamination from other vehicle components (e.g., causing shorting between pins).
264	Hazardous interaction with other components in the rest of the vehicle	Excessive heat from other components	Excessive heat from other vehicle components may affect the connection between the brake/stability control module and ACS/ETC control module (e.g., melting of wiring).
265	Hazardous interaction with other components in the rest of the vehicle	Physical interference (e.g., chafing)	Physical interference from other vehicle components may affect the connection between the brake/stability control module and ACS/ETC control module (e.g., damage to wiring).
266	Hazardous interaction with other components in the rest of the vehicle	Active connection terminals affected by moisture, corrosion, or contamination	Moisture, corrosion, or contamination from other vehicle components may affect the active connection terminals of the brake/stability control module or ACS/ETC control module.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
267	Hazardous interaction with other components in the rest of the vehicle	Electrical arcing from neighboring components or exposed terminals	Electrical arcing from neighboring components or exposed terminals may affect the connection between the brake/stability control module and ACS/ETC control module.
601	Controller to actuator signal ineffective, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connection is intermittent	An intermittent connection between the brake/stability control module and the ACS/ETC control module may affect requests to adjust the ACS/ETC torque output.
602	Controller to actuator signal ineffective, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connection is open, short to ground, short to battery, or short to other wires in harness	If the connection between the brake/stability control module and the ACS/ETC control module is open or shorted (e.g., to ground, battery, or other wires), this may affect requests to adjust the ACS/ETC torque output.
603	Controller to actuator signal ineffective, missing, or delayed: Hardware open, short, missing, intermittent faulty	Electrical noise other than EMI or ESD	Electrical noise, other than EMI or ESD, may corrupt the torque adjustment request as it's transmitted from the brake/stability control module to the ACS/ETC control module.
604	Controller to actuator signal ineffective, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connector contact resistance is too high	The contact resistance in the connectors for the brake/stability control module or ACS/ETC control module may be too high, affecting the request to adjust the ACS/ETC torque output.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
605	Controller to actuator signal ineffective, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connector shorting between neighboring pins	Shorting between neighboring pins in the connectors for the brake/stability control module or ACS/ETC control module may affect requests to adjust the ACS/ETC torque output.
606	Controller to actuator signal ineffective, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connector resistive drift between neighboring pins	Resistive drift between neighboring pins in the connectors for the brake/stability control module or ACS/ETC control module may affect requests to adjust the ACS/ETC torque output.
607	Controller to actuator signal ineffective, missing, or delayed: Communication bus error	Bus overload or bus error	If the brake/stability control module and ACS/ETC system communicate via the communication bus, a bus overload or bus error may prevent requests to adjust the ACS/ETC torque output.
608	Controller to actuator signal ineffective, missing, or delayed: Communication bus error	Signal priority too low	If the brake/stability control module and ACS/ETC system communicate via the communication bus, the signal priority for torque adjustment requests may be too low.
609	Controller to actuator signal ineffective, missing, or delayed: Communication bus error	Failure of the message generator, transmitter, or receiver	If the brake/stability control module and ACS/ETC system communicate via the communication bus, failure of the message generator, transmitter, or receiver may prevent a torque adjustment request from being written to the bus.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
610	Controller to actuator signal ineffective, missing, or delayed: Communication bus error	Malicious Intruder	If the brake/stability control module and ACS/ETC system communicate via the communication bus, a malicious intruder or aftermarket component may write a message to the communication bus that mimics a torque adjustment request.
611	Controller to actuator signal ineffective, missing, or delayed: Incorrect connection	Incorrect wiring connection	The connection between the brake/stability control module and ACS/ETC control module may be incorrectly wired, affecting requests to adjust the ACS/ETC torque output.
612	Controller to actuator signal ineffective, missing, or delayed: Incorrect connection	Incorrect pin assignment	The connection between the brake/stability control module and ACS/ETC control module may have an incorrect pin assignment, affecting requests to adjust the ACS/ETC torque output.

Table I-22: CHB Control Module to Brake Modulator

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
125	Controller to actuator signal ineffective, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connection is intermittent	An intermittent connection between the brake/stability control module and brake modulator may cause the brake modulator to incorrectly regulate the brake fluid pressure.
126	Controller to actuator signal ineffective, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connection is open, short to ground, short to battery, or short to other wires in harness	A fault in the connection between the brake/stability control module and brake modulator (e.g., open, or shorted to ground or battery) may cause the brake modulator to receive an incorrect signal for modulating the brake fluid pressure.
127	Controller to actuator signal ineffective, missing, or delayed: Hardware open, short, missing, intermittent faulty	Electrical noise other than EMI or ESD	Electrical noise, other than EMI or ESD, may affect the signal from the brake/stability control module to the brake modulator.
128	Controller to actuator signal ineffective, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connector contact resistance is too high	The contact resistance in the connectors for the brake/stability control module or brake modulator may be too high, affecting the signal.
129	Controller to actuator signal ineffective, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connector shorting between neighboring pins	Shorting between pins in the connectors for the brake/stability control module or brake modulator may affect the signal.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
130	Controller to actuator signal ineffective, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connector resistive drift between neighboring pins	Resistive drift between neighboring pins in the connectors for the brake/stability control module or brake modulator may affect the signal.
131	Controller to actuator signal ineffective, missing, or delayed: Communication bus error	Bus overload or bus error	If the signal from the brake/stability control module to the brake modulator is transmitted over the communication bus, a bus overload or error may prevent the brake modulator from receiving the signal.
132	Controller to actuator signal ineffective, missing, or delayed: Communication bus error	Signal priority too low	If the signal from the brake/stability control module to the brake modulator is transmitted over the communication bus, the signal priority from the brake/stability control module may be too low.
133	Controller to actuator signal ineffective, missing, or delayed: Communication bus error	Failure of the message generator, transmitter, or receiver	If the signal from the brake/stability control module to the brake modulator is transmitted over the communication bus, a failure of the message generator, transmitter, or receiver may prevent the signal from reaching the brake modulator.
134	Controller to actuator signal ineffective, missing, or delayed: Communication bus error	Malicious Intruder	If the signal from the brake/stability control module to the brake modulator is transmitted over the communication bus, a malicious intruder or aftermarket component may write a signal to the communication bus that mimics a signal from the brake/stability control module.
135	Controller to actuator signal ineffective, missing, or delayed: Incorrect connection	Incorrect wiring connection	The connection between the brake/stability control module and the brake modulator may be incorrectly wired, causing the brake modulator to receive an incorrect signal (e.g., release pressure instead of accumulate pressure).

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
136	Controller to actuator signal ineffective, missing, or delayed: Incorrect connection	Incorrect pin assignment	The brake/stability control module or brake modulator may have an incorrect pin assignment, affecting the signal to the brake modulator.
137	External disturbances	EMI or ESD	EMI or ESD from the external environment may affect the signal from the brake/stability control module to the brake modulator.
138	External disturbances	Vibration or shock impact	Vibration or shock impact from the external environment may affect the connection between the brake/stability control module and the brake modulator.
139	External disturbances	Manufacturing defects and assembly problems	Manufacturing defects or assembly problems may affect the connection between the brake/stability control module and the brake modulator.
140	External disturbances	Extreme external temperature or thermal cycling	Extreme external temperature or thermal cycling may affect the connection between the brake/stability control module and the brake modulator (e.g., degradation of wiring insulation).
141	External disturbances	Unused connection terminals affected by moisture, corrosion, or contamination	Unused connection terminals in the wiring harness connecting the brake/stability control module and brake modulator may be affected by moisture, corrosion, or contamination. This may cause shorting between pins in the harness (e.g., short to battery).
142	External disturbances	Physical interference (e.g., chafing)	Physical interference from the external environment (e.g., road debris) may affect the connection between the brake/stability control module and the brake modulator (e.g., damage the wiring).
143	External disturbances	Active connection terminals affected by moisture, corrosion, or contamination	Moisture, corrosion, or contamination from the external environment may affect the active connection terminals of the brake/stability control module or brake modulator (e.g., cause shorting between pins).

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
144	Hazardous interaction with other components in the rest of the vehicle	EMI or ESD	EMI or ESD from other vehicle components may affect the signal from the brake/stability control module to the brake modulator.
145	Hazardous interaction with other components in the rest of the vehicle	Vibration or shock impact	Vibration or shock impact from other vehicle components may affect the connection between the brake/stability control module and the brake modulator (e.g., wiring comes loose).
146	Hazardous interaction with other components in the rest of the vehicle	Physical interference (e.g., chafing)	Physical interference from other vehicle components may affect the connection between the brake/stability control module and the brake modulator (e.g., chafing).
147	Hazardous interaction with other components in the rest of the vehicle	Unused connection terminals affected by moisture, corrosion, or contamination	Unused connection terminals in the wiring harness connecting the brake/stability control module and brake modulator may be affected by moisture, corrosion, or contamination from other vehicle components. This may cause shorting between pins in the harness (e.g., short to battery).
148	Hazardous interaction with other components in the rest of the vehicle	Active connection terminals affected by moisture, corrosion, or contamination	Moisture, corrosion, or contamination from other vehicle components may affect the active connection terminals of the brake/stability control module or brake modulator (e.g., cause shorting between pins).
149	Hazardous interaction with other components in the rest of the vehicle	Excessive heat from other components	Excessive heat from other vehicle components may affect the connection between the brake/stability control module and brake modulator (e.g., melt wiring).

Table I-23: CHB Control Module to Steering System

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
622	Controller to actuator signal ineffective, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connection is intermittent	The connection between the brake/stability control module and steering system may become intermittent, affecting transmission of the steering request.
623	Controller to actuator signal ineffective, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connection is open, short to ground, short to battery, or short to other wires in harness	The connection between the brake/stability control module and steering system may become open or shorted (e.g., short to ground, battery, or other wires).
624	Controller to actuator signal ineffective, missing, or delayed: Hardware open, short, missing, intermittent faulty	Electrical noise other than EMI or ESD	Electrical noise, other than EMI or ESD, could affect the signal from the brake/stability control module to the steering system.
625	Controller to actuator signal ineffective, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connector contact resistance is too high	The contact resistance in the connectors for the brake/stability control module or steering system may be too high.
626	Controller to actuator signal ineffective, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connector shorting between neighboring pins	Shorting between pins in the connectors for the brake/stability control module or steering system could affect the steering request.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
627	Controller to actuator signal ineffective, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connector resistive drift between neighboring pins	Resistive drift between neighboring pins in the connectors for the brake/stability control module or steering system could affect the steering request.
628	Controller to actuator signal ineffective, missing, or delayed: Communication bus error	Bus overload or bus error	If the brake/stability control module and steering system communicate over the communication bus, a bus overload or error could affect transmission of the steering request.
629	Controller to actuator signal ineffective, missing, or delayed: Communication bus error	Signal priority too low	If the brake/stability control module and steering system communicate over the communication bus, the signal priority from the brake/stability control module may be too low.
630	Controller to actuator signal ineffective, missing, or delayed: Communication bus error	Failure of the message generator, transmitter, or receiver	If the brake/stability control module and steering system communicate over the communication bus, failure of the message generator, transmitter, or receiver may affect transmission of the steering request.
631	Controller to actuator signal ineffective, missing, or delayed: Communication bus error	Malicious Intruder	If the brake/stability control module and steering system communicate over the communication bus, a malicious intruder or aftermarket component may write a signal to the communication bus that mimics a steering request.
632	Controller to actuator signal ineffective, missing, or delayed: Incorrect connection	Incorrect wiring connection	The connection between the brake/stability control module and steering system may be incorrectly wired, affecting transmission of the steering request.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
633	Controller to actuator signal ineffective, missing, or delayed: Incorrect connection	Incorrect pin assignment	The connection between the brake/stability control module and steering system may have an incorrect pin assignment, affecting transmission of the steering request.

Table I-24: Disable Stability Control Switch to CHB Control Module

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
411	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connection is intermittent	An intermittent connection between the button that disables stability control and the brake/stability control module may cause the stability or traction control feature to inadvertently activate/deactivate.
412	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connection is open, short to ground, short to battery, or short to other wires in harness	The connection between the button that disables stability control and the brake/stability control module may become open or shorted (e.g., to ground, batter, or other wires), causing the stability or traction control feature to inadvertently activate/deactivate.
413	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Electrical noise other than EMI or ESD	Electrical noise, other than EMI or ESD, may affect the connection between the button that disables stability control and the brake/stability control module, causing the stability or traction control feature to inadvertently activate/deactivate.
414	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connector contact resistance is too high	The contact resistance in the connection terminals of the button that disables stability control or the brake/stability control module may affect the signal, causing the stability or traction control feature to inadvertently activate/deactivate.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
415	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connector shorting between neighboring pins	Shorting between pins in the connection terminals of the button that disables stability control or the brake/stability control module may affect the signal, causing the stability or traction control feature to inadvertently activate/deactivate.
416	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connector resistive drift between neighboring pins	Resistive drift between pins in the connection terminals of the button that disables stability control or the brake/stability control module may affect the signal, causing the stability or traction control feature to inadvertently activate/deactivate.
417	Sensor to controller signal inadequate, missing, or delayed: Communication bus error	Bus overload or bus error	If the signal from the stability control button to the brake/stability control module is transmitted over the communication bus, a bus overload or bus error may cause the stability or traction control feature to inadvertently activate/deactivate.
418	Sensor to controller signal inadequate, missing, or delayed: Communication bus error	Bus overload or bus error	If the signal from the stability control button to the brake/stability control module is transmitted over the communication bus, a bus overload or bus error may cause the stability or traction control feature to remain activated/deactivated.
419	Sensor to controller signal inadequate, missing, or delayed: Communication bus error	Signal priority too low	If the signal from the stability control button to the brake/stability control module is transmitted over the communication bus, the signal priority for the stability control button may be too low, delaying activation/deactivation of the stability or traction control feature.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
420	Sensor to controller signal inadequate, missing, or delayed: Communication bus error	Failure of the message generator, transmitter, or receiver	If the signal from the stability control button to the brake/stability control module is transmitted over the communication bus, a failure of the message generator, transmitter, or receiver may prevent the signal from reaching the brake/stability control module. This may prevent activation/deactivation of the stability or traction control feature.
421	Sensor to controller signal inadequate, missing, or delayed: Communication bus error	Malicious Intruder	If the signal from the stability control button to the brake/stability control module is transmitted over the communication bus, a malicious intruder or aftermarket component may write a signal to the bus that mimics the stability control button. This may cause inadvertent activation/deactivation of the stability or traction control feature.
422	Sensor to controller signal inadequate, missing, or delayed: Incorrect connection	Incorrect wiring connection	The wiring harness connecting the stability control button and the brake/stability control module may be incorrectly wired. This may cause inadvertent activation/deactivation of the stability or traction control feature.
423	Sensor to controller signal inadequate, missing, or delayed: Incorrect connection	Incorrect pin assignment	The wiring harness connecting the stability control button and the brake/stability control module may have an incorrect pin assignment. This may cause inadvertent activation/deactivation of the stability or traction control feature.
424	External disturbances	EMI or ESD	EMI or ESD from the external environment may affect the signal from the stability control button to the brake/stability control module. This may cause inadvertent activation/deactivation of the stability or traction control feature.
425	External disturbances	Vibration or shock impact	Vibration or shock impact from the external environment may affect the connection between the stability control button and the brake/stability control module (e.g., fretting). This may cause inadvertent activation/deactivation of the stability or traction control feature.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
426	External disturbances	Manufacturing defects and assembly problems	Manufacturing defects or assembly problems may affect the connection between the stability control button and the brake/stability control module. This may cause inadvertent activation/deactivation of the stability or traction control feature.
427	External disturbances	Extreme external temperature or thermal cycling	Extreme external temperature or thermal cycling may affect the connection between the stability control button and the brake/stability control module (e.g., degrade the wiring). This may cause inadvertent activation/deactivation of the stability or traction control feature.
428	External disturbances	Unused connection terminals affected by moisture, corrosion, or contamination	Unused connection terminals in the wiring harness connecting the stability control button and the brake/stability control module may be affected by moisture, corrosion, or contamination (e.g., shorting between pins) from the external environment. This may cause inadvertent activation/deactivation of the stability or traction control feature.
429	External disturbances	Organic growth	Organic growth may affect the connection terminals of the stability control button or the brake/stability control module. This may cause inadvertent activation/deactivation of the stability or traction control feature.
430	External disturbances	Physical interference (e.g., chafing)	Physical interference from the external environment may affect the connection between the stability control button and the brake/stability control module. This may cause inadvertent activation/deactivation of the stability or traction control feature.
431	External disturbances	Active connection terminals affected by moisture, corrosion, or contamination	Moisture, corrosion, or contamination from the external environment may affect the active connection terminals of the stability control button or brake/stability control module. This may cause inadvertent activation/deactivation of the stability or traction control feature.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
432	Hazardous interaction with other components in the rest of the vehicle	EMI or ESD	EMI or ESD from other vehicle components may affect the signal from the stability control button to the brake/stability control module. This may cause inadvertent activation/deactivation of the stability or traction control feature.
433	Hazardous interaction with other components in the rest of the vehicle	Vibration or shock impact	Vibration or shock impact from other vehicle components may affect the connection between the stability control button and the brake/stability control module (e.g., fretting). This may cause inadvertent activation/deactivation of the stability or traction control feature.
434	Hazardous interaction with other components in the rest of the vehicle	Excessive heat from other components	Excessive heat from other vehicle components may affect the connection between the stability control button and the brake/stability control module (e.g., melt the wiring). This may cause inadvertent activation/deactivation of the stability or traction control feature.
435	Hazardous interaction with other components in the rest of the vehicle	Unused connection terminals affected by moisture, corrosion, or contamination	Unused connection terminals in the wiring harness connecting the stability control button and the brake/stability control module may be affected by moisture, corrosion, or contamination (e.g., shorting between pins) from other vehicle components. This may cause inadvertent activation/deactivation of the stability or traction control feature.
436	Hazardous interaction with other components in the rest of the vehicle	Physical interference (e.g., chafing)	Physical interference from other vehicle components may affect the connection between the stability control button and the brake/stability control module. This may cause inadvertent activation/deactivation of the stability or traction control feature.
437	Hazardous interaction with other components in the rest of the vehicle	Active connection terminals affected by moisture, corrosion, or contamination	Moisture, corrosion, or contamination from other vehicle components may affect the active connection terminals of the stability control button or brake/stability control module. This may cause inadvertent activation/deactivation of the stability or traction control feature.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
438	Hazardous interaction with other components in the rest of the vehicle	Electrical arcing from neighboring components or exposed terminals	Electrical arcing from other vehicle components or exposed terminals may affect the connection between the stability control button and the brake/stability control module. This may cause inadvertent activation/deactivation of the stability or traction control feature.

Table I-25: Lateral Acceleration Sensor to CHB Control Module

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
439	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connection is intermittent	The connection between the lateral acceleration sensor and the brake/stability control module may become intermittent. This may affect the brake/stability control module's ability to determine the vehicle's yaw error.
440	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connection is open, short to ground, short to battery, or short to other wires in harness	The connection between the lateral acceleration sensor and the brake/stability control module may become open or shorted (e.g., to ground, battery, or other wires). This may affect the brake/stability control module's ability to determine the vehicle's yaw error.
441	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Electrical noise other than EMI or ESD	Electrical noise, other than EMI or ESD, may affect the connection between the lateral acceleration sensor and the brake/stability control module. This may affect the brake/stability control module's ability to determine the vehicle's yaw error.
442	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connector contact resistance is too high	The contact resistance in the connectors for the lateral acceleration sensor or the brake/stability control module may be too high. This may affect the brake/stability control module's ability to determine the vehicle's yaw error.
443	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connector shorting between neighboring pins	Shorting may occur between neighboring pins in the connectors for the lateral acceleration sensor or the brake/stability control module. This may affect the brake/stability control module's ability to determine the vehicle's yaw error.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
444	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connector resistive drift between neighboring pins	Resistive drift may occur between neighboring pins in the connectors for the lateral acceleration sensor or the brake/stability control module. This may affect the brake/stability control module's ability to determine the vehicle's yaw error.
445	Sensor to controller signal inadequate, missing, or delayed: Communication bus error	Bus overload or bus error	If the lateral acceleration sensor and brake/stability control module communicate over the communication bus, a bus overload or bus error may affect transmission of the lateral acceleration data. This may affect the brake/stability control module's ability to determine the vehicle's yaw error.
446	Sensor to controller signal inadequate, missing, or delayed: Communication bus error	Signal priority too low	If the lateral acceleration sensor and brake/stability control module communicate over the communication bus, the lateral acceleration sensor signal priority may be too low. This may affect the brake/stability control module's ability to determine the vehicle's yaw error.
447	Sensor to controller signal inadequate, missing, or delayed: Communication bus error	Failure of the message generator, transmitter, or receiver	If the lateral acceleration sensor and brake/stability control module communicate over the communication bus, failure of the message generator, transmitter, or receiver may affect transmission of the lateral acceleration data. This may affect the brake/stability control module's ability to determine the vehicle's yaw error.
448	Sensor to controller signal inadequate, missing, or delayed: Communication bus error	Malicious Intruder	If the lateral acceleration sensor and brake/stability control module communicate over the communication bus, a malicious intruder or aftermarket component may write data to the communication bus that mimics lateral acceleration data. This may affect the brake/stability control module's ability to determine the vehicle's yaw error.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
449	Sensor to controller signal inadequate, missing, or delayed: Incorrect connection	Incorrect wiring connection	The wiring harness connecting the lateral acceleration sensor and brake/stability control module may be incorrectly wired. This may affect the brake/stability control module's ability to determine the vehicle's yaw error.
450	Sensor to controller signal inadequate, missing, or delayed: Incorrect connection	Incorrect pin assignment	The wiring harness connecting the lateral acceleration sensor and brake/stability control module may have an incorrect pin assignment. This may affect the brake/stability control module's ability to determine the vehicle's yaw error.
451	External disturbances	EMI or ESD	EMI or ESD from the external environment may affect the signal from the lateral acceleration sensor to the brake/stability control module. This may affect the brake/stability control module's ability to determine the vehicle's yaw error.
452	External disturbances	Vibration or shock impact	Vibration or shock impact from the external environment may affect the connection between the lateral acceleration sensor and the brake/stability control module (e.g., fretting). This may affect the brake/stability control module's ability to determine the vehicle's yaw error.
453	External disturbances	Manufacturing defects and assembly problems	Manufacturing defects or assembly problems may affect the connection between the lateral acceleration sensor and the brake/stability control module. This may affect the brake/stability control module's ability to determine the vehicle's yaw error.
454	External disturbances	Extreme external temperature or thermal cycling	Extreme external temperature or thermal cycling may affect the connection between the lateral acceleration sensor and the brake/stability control module (e.g., degrade wiring insulation). This may affect the brake/stability control module's ability to determine the vehicle's yaw error.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
455	External disturbances	Unused connection terminals affected by moisture, corrosion, or contamination	Unused connection terminals in the wiring harness connecting the lateral acceleration sensor and brake/stability control module may be affected by moisture, corrosion, or contamination from the external environment. This may affect the brake/stability control module's ability to determine the vehicle's yaw error.
456	External disturbances	Organic growth	Organic growth may affect the connection between the lateral acceleration sensor and the brake/stability control module. This may affect the brake/stability control module's ability to determine the vehicle's yaw error.
457	External disturbances	Physical interference (e.g., chafing)	Physical interference from the external environment (e.g., road debris) may affect the connection between the lateral acceleration sensor and the brake/stability control module. This may affect the brake/stability control module's ability to determine the vehicle's yaw error.
458	External disturbances	Active connection terminals affected by moisture, corrosion, or contamination	Moisture, corrosion, or contamination from the external environment may affect the active connection terminals of the lateral acceleration sensor or the brake/stability control module (e.g., causing shorting). This may affect the brake/stability control module's ability to determine the vehicle's yaw error.
459	Hazardous interaction with other components in the rest of the vehicle	EMI or ESD	EMI or ESD from other vehicle components may affect the signal from the lateral acceleration sensor to the brake/stability control module. This may affect the brake/stability control module's ability to determine the vehicle's yaw error.
460	Hazardous interaction with other components in the rest of the vehicle	Vibration or shock impact	Vibration or shock impact from other vehicle components may affect the connection between the lateral acceleration sensor and the brake/stability control module (e.g., fretting). This may affect the brake/stability control module's ability to determine the vehicle's yaw error.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
461	Hazardous interaction with other components in the rest of the vehicle	Excessive heat from other components	Excessive heat from other vehicle components may affect the connection between the lateral acceleration sensor and the brake/stability control module (e.g., melt the wiring). This may affect the brake/stability control module's ability to determine the vehicle's yaw error.
462	Hazardous interaction with other components in the rest of the vehicle	Unused connection terminals affected by moisture, corrosion, or contamination	Unused connection terminals in the wiring harness connecting the lateral acceleration sensor and brake/stability control module may be affected by moisture, corrosion, or contamination from other vehicle components. This may affect the brake/stability control module's ability to determine the vehicle's yaw error.
463	Hazardous interaction with other components in the rest of the vehicle	Physical interference (e.g., chafing)	Physical interference from other vehicle components may affect the connection between the lateral acceleration sensor and the brake/stability control module. This may affect the brake/stability control module's ability to determine the vehicle's yaw error.
464	Hazardous interaction with other components in the rest of the vehicle	Active connection terminals affected by moisture, corrosion, or contamination	Moisture, corrosion, or contamination from other vehicle components may affect the active connection terminals of the lateral acceleration sensor or the brake/stability control module (e.g., causing shorting). This may affect the brake/stability control module's ability to determine the vehicle's yaw error.
465	Hazardous interaction with other components in the rest of the vehicle	Electrical arcing from neighboring components or exposed terminals	Electrical arcing from other vehicle components or exposed terminals may damage the connection between the lateral acceleration sensor and the brake/stability control module. This may affect the brake/stability control module's ability to determine the vehicle's yaw error.

Table I-26: Master Cylinder/Hydraulic Reservoir to Brake Modulator

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
699	Actuation delivered incorrectly or inadequately: Hardware faulty	Actuation delivered incorrectly or inadequately: Hardware faulty	A hardware fault (e.g., leaking hose) may affect the connection between the master cylinder and brake modulator.
700	Actuation delivered incorrectly or inadequately: Actuation delayed	Actuation delivered incorrectly or inadequately: Actuation delayed	A hardware fault (e.g., leaking hose) may cause a delay in transmitting pressurized hydraulic fluid from the master cylinder to the brake modulator.
701	Actuation delivered incorrectly or inadequately: Incorrect connection	Actuation delivered incorrectly or inadequately: Incorrect connection	The connection between the master cylinder and brake modulator may be incorrect (e.g., brake circuits one and two are reversed).
702	External disturbances	Vibration or shock impact	Vibration or shock impact from the external environment may affect the connection between the master cylinder and brake modulator (e.g., damage hosing).
703	External disturbances	Manufacturing defects and assembly problems	Manufacturing defects or assembly problems may affect the connection between the master cylinder and brake modulator.
704	External disturbances	Extreme external temperature or thermal cycling	Extreme external temperature or thermal cycling may affect the brake fluid in the hose connecting the master cylinder and brake modulator.
705	External disturbances	Physical interference (e.g., chafing)	Physical interference from the external environment may damage the connection between the master cylinder and brake modulator.
706	External disturbances	Mechanical connections affected by moisture, corrosion, or contamination	Moisture, corrosion, or contamination from the external environment may damage the connection between the master cylinder and brake modulator.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
707	Hazardous interaction with other components in the rest of the vehicle	Mechanical connections affected by moisture, corrosion, or contamination	Moisture, corrosion, or contamination from other vehicle components may damage the connection between the master cylinder and brake modulator.
708	Hazardous interaction with other components in the rest of the vehicle	Vibration or shock impact	Vibration or shock impact from other vehicle components may damage the connection between the master cylinder and brake modulator.
709	Hazardous interaction with other components in the rest of the vehicle	Physical interference (e.g., chafing)	Physical interference from other vehicle components may damage the connection between the master cylinder and brake modulator.
710	Hazardous interaction with other components in the rest of the vehicle	Excessive heat from other components	Excessive heat from other vehicle components may affect the brake fluid in the hose connecting the master cylinder and brake modulator.

Table I-27: Master Cylinder/Hydraulic Reservoir to Brake Pressure Sensor

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
723	Sensor measurement incorrect or missing	Sensor incorrectly aligned or positioned	The brake pressure sensor may be incorrectly positioned or aligned, resulting in a brake pressure measurement that is missing or out of range.
724	Sensor measurement inaccurate	Sensor incorrectly aligned or positioned	The brake pressure sensor may be incorrectly positioned or aligned, resulting in an incorrect measurement of the brake pressure (but within the expected range).
725	Sensor measurement delay	Sensor incorrectly aligned or positioned	The brake pressure sensor may be incorrectly positioned or aligned, resulting in a delayed measurement of the brake pressure.
726	External disturbances	Vibration or shock impact	Vibration or shock impact from the external environment could affect the interface between the brake pressure sensor and master cylinder, affecting the brake fluid pressure measurement.
727	External disturbances	Manufacturing defects and assembly problems	Manufacturing defects or assembly problems could affect the interface between the brake pressure sensor and master cylinder, affecting the brake fluid pressure measurement.
728	External disturbances	Extreme external temperature or thermal cycling	Extreme external temperatures or thermal cycling could affect the interface between the brake pressure sensor and master cylinder, affecting the brake fluid pressure measurement.
729	External disturbances	Physical interference (e.g., chafing)	Physical interference from the external environment could affect the interface between the brake pressure sensor and master cylinder, affecting the brake fluid pressure measurement.
730	External disturbances	Mechanical connections affected by moisture, corrosion, or contamination	Moisture, corrosion, or contamination from the external environment could affect the interface between the brake pressure sensor and master cylinder, affecting the brake fluid pressure measurement.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
731	Hazardous interaction with other components in the rest of the vehicle	Mechanical connections affected by moisture, corrosion, or contamination	Moisture, corrosion, or contamination from other vehicle components could affect the interface between the brake pressure sensor and master cylinder, affecting the brake fluid pressure measurement.
732	Hazardous interaction with other components in the rest of the vehicle	Vibration or shock impact	Vibration or shock impact from other vehicle components could affect the interface between the brake pressure sensor and master cylinder, affecting the brake fluid pressure measurement.
733	Hazardous interaction with other components in the rest of the vehicle	Physical interference (e.g., chafing)	Physical interference from other vehicle components could affect the interface between the brake pressure sensor and master cylinder, affecting the brake fluid pressure measurement.
734	Hazardous interaction with other components in the rest of the vehicle	Excessive heat from other components	Excessive heat from other vehicle components could affect the interface between the brake pressure sensor and master cylinder, affecting the brake fluid pressure measurement.

Table I-28: Steering System to CHB Control Module

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
466	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connection is intermittent	The connection between the steering system and brake/stability control module may become intermittent. This may affect transmission of the steering wheel sensor data, affecting the brake/stability control module's ability to determine the driver's steering intent.
467	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connection is open, short to ground, short to battery, or short to other wires in harness	The connection between the steering system and brake/stability control module may become open or shorted (e.g., to ground, battery, or other wires). This may affect transmission of the steering wheel sensor data, affecting the brake/stability control module's ability to determine the driver's steering intent.
468	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Electrical noise other than EMI or ESD	Electrical noise, other than EMI or ESD, may affect the connection between the steering system and brake/stability control module. This may affect transmission of the steering wheel sensor data, affecting the brake/stability control module's ability to determine the driver's steering intent.
469	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connector contact resistance is too high	The contact resistance in the connection terminals of the steering wheel sensors or brake/stability control module may be too high. This may affect transmission of the steering wheel sensor data, affecting the brake/stability control module's ability to determine the driver's steering intent.
470	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connector shorting between neighboring pins	Shorting may occur between pins in the connection terminals of the steering wheel sensors or brake/stability control module. This may affect transmission of the steering wheel sensor data, affecting the brake/stability control module's ability to determine the driver's steering intent.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
471	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connector resistive drift between neighboring pins	Resistive drift may occur between pins in the connection terminals of the steering wheel sensors or brake/stability control module. This may affect transmission of the steering wheel sensor data, affecting the brake/stability control module's ability to determine the driver's steering intent.
472	Sensor to controller signal inadequate, missing, or delayed: Communication bus error	Bus overload or bus error	If the steering wheel sensor data is transmitted over the communication bus, a bus overload or bus error may affect transmission of the steering wheel sensor data. This could affect the brake/stability control module's ability to determine the driver's steering intent.
473	Sensor to controller signal inadequate, missing, or delayed: Communication bus error	Signal priority too low	If the steering wheel sensor data is transmitted over the communication bus, the steering wheel sensor signal priority may be too low. This could may delay the brake/stability control module's ability to determine the driver's steering intent.
474	Sensor to controller signal inadequate, missing, or delayed: Communication bus error	Failure of the message generator, transmitter, or receiver	If the steering wheel sensor data is transmitted over the communication bus, failure of the message generator, transmitter, or receiver may affect transmission of the steering wheel sensor data. This could affect the brake/stability control module's ability to determine the driver's steering intent.
475	Sensor to controller signal inadequate, missing, or delayed: Communication bus error	Malicious Intruder	If the steering wheel sensor data is transmitted over the communication bus, a malicious intruder or aftermarket component may write data to the communication bus that mimics the steering wheel sensor data. This could affect the brake/stability control module's ability to determine the driver's steering intent.
476	Sensor to controller signal inadequate, missing, or delayed: Incorrect connection	Incorrect wiring connection	The wiring harness connecting the steering system and brake/stability control module may be incorrectly wired. This could affect the brake/stability control module's ability to determine the driver's steering intent.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
477	Sensor to controller signal inadequate, missing, or delayed: Incorrect connection	Incorrect pin assignment	The wiring harness connecting the steering system and brake/stability control module may have an incorrect pin assignment. This could affect the brake/stability control module's ability to determine the driver's steering intent.
478	External disturbances	EMI or ESD	EMI or ESD from the external environment could affect the connection between the steering system and brake/stability control module. This could affect the brake/stability control module's ability to determine the driver's steering intent.
479	External disturbances	Vibration or shock impact	Vibration or shock impact from the external environment could affect the connection between the steering system and brake/stability control module. This could affect the brake/stability control module's ability to determine the driver's steering intent.
480	External disturbances	Manufacturing defects and assembly problems	Manufacturing defects or assembly problems could affect the connection between the steering system and brake/stability control module. This could affect the brake/stability control module's ability to determine the driver's steering intent.
481	External disturbances	Extreme external temperature or thermal cycling	Extreme external temperatures or thermal cycling could affect the connection between the steering system and brake/stability control module (e.g., degrade the wiring insulation). This could affect the brake/stability control module's ability to determine the driver's steering intent.
482	External disturbances	Unused connection terminals affected by moisture, corrosion, or contamination	Unused connection terminals in the wiring harness connecting the steering system and brake/stability control module may be affected by moisture, corrosion, or contamination from the external environment. This could affect the brake/stability control module's ability to determine the driver's steering intent.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
483	External disturbances	Organic growth	Organic growth may affect the connection terminals of the steering wheel sensors or brake/stability control module. This could affect the brake/stability control module's ability to determine the driver's steering intent.
484	External disturbances	Active connection terminals affected by moisture, corrosion, or contamination	Moisture, corrosion, or contamination from the external environment may affect the connection terminals of the steering wheel sensors or brake/stability control module. This could affect the brake/stability control module's ability to determine the driver's steering intent.
485	External disturbances	Physical interference (e.g., chafing)	Physical interference from the external environment (e.g., road debris) may affect the connection between the steering system and brake/stability control module. This could affect the brake/stability control module's ability to determine the driver's steering intent.
486	Hazardous interaction with other components in the rest of the vehicle	EMI or ESD	EMI or ESD from other vehicle components could affect the connection between the steering system and brake/stability control module. This could affect the brake/stability control module's ability to determine the driver's steering intent.
487	Hazardous interaction with other components in the rest of the vehicle	Vibration or shock impact	Vibration or shock impact from other vehicle components could affect the connection between the steering system and brake/stability control module. This could affect the brake/stability control module's ability to determine the driver's steering intent.
488	Hazardous interaction with other components in the rest of the vehicle	Excessive heat from other components	Excessive heat from other vehicle components could affect the connection between the steering system and brake/stability control module (e.g., melt the wiring). This could affect the brake/stability control module's ability to determine the driver's steering intent.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
489	Hazardous interaction with other components in the rest of the vehicle	Unused connection terminals affected by moisture, corrosion, or contamination	Unused connection terminals in the wiring harness connecting the steering system and brake/stability control module may be affected by moisture, corrosion, or contamination from other vehicle components. This could affect the brake/stability control module's ability to determine the driver's steering intent.
490	Hazardous interaction with other components in the rest of the vehicle	Active connection terminals affected by moisture, corrosion, or contamination	Moisture, corrosion, or contamination from other vehicle components may affect the connection terminals of the steering wheel sensors or brake/stability control module. This could affect the brake/stability control module's ability to determine the driver's steering intent.
491	Hazardous interaction with other components in the rest of the vehicle	Physical interference (e.g., chafing)	Physical interference from other vehicle components may affect the connection between the steering system and brake/stability control module. This could affect the brake/stability control module's ability to determine the driver's steering intent.
492	Hazardous interaction with other components in the rest of the vehicle	Electrical arcing from neighboring components or exposed terminals	Electrical arcing from other vehicle components or exposed terminals may affect the connection terminals of the steering wheel sensors or brake/stability control module. This could affect the brake/stability control module's ability to determine the driver's steering intent.

Table I-29: Vehicle to Lateral Acceleration Sensor

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
558	Sensor measurement incorrect or missing	Sensor incorrectly aligned or positioned	The lateral acceleration sensor may be incorrectly aligned or positioned in the vehicle, preventing a lateral acceleration measurement or resulting in a measurement that is out-of-range.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
559	Sensor measurement inaccurate	Sensor incorrectly aligned or positioned	The lateral acceleration sensor may be incorrectly aligned or positioned in the vehicle, preventing an inaccurate lateral acceleration measurement (e.g., offset).
560	External disturbances	Vibration or shock impact	Vibration or shock impact from the external environment may affect the connection between the vehicle and lateral acceleration sensor (e.g., displace or offset the lateral acceleration sensor).
561	External disturbances	Manufacturing defects and assembly problems	Manufacturing defects or assembly problems may affect the positioning of the lateral acceleration sensor relative to the vehicle (e.g., improper installation).
562	External disturbances	Physical interference (e.g., chafing)	Physical interference from the external environment may affect the connection between the lateral acceleration sensor and the vehicle (e.g., dislocate the sensor).
563	External disturbances	Mechanical connections affected by moisture, corrosion, or contamination	The mechanical connection between the lateral acceleration sensor and the vehicle may be damaged by moisture, corrosion, or contamination from the external environment (e.g., degradation of the mechanical fixtures holding the sensor in place).
564	Hazardous interaction with other components in the rest of the vehicle	Vibration or shock impact	Vibration or shock impact from other vehicle components may affect the connection between the vehicle and lateral acceleration sensor (e.g., displace or offset the lateral acceleration sensor).
565	Hazardous interaction with other components in the rest of the vehicle	Physical interference (e.g., chafing)	Physical interference from other vehicle components may affect the connection between the lateral acceleration sensor and the vehicle (e.g., dislocate the sensor).

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
566	Hazardous interaction with other components in the rest of the vehicle	Mechanical connections affected by moisture, corrosion, or contamination	The mechanical connection between the lateral acceleration sensor and the vehicle may be damaged by moisture, corrosion, or contamination from other vehicle components (e.g., degradation of the mechanical fixtures holding the sensor in place).

Table I-30: Vehicle to Wheel Speed Sensor

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
56	Sensor measurement incorrect or missing	Sensor incorrectly aligned or positioned	If the wheel speed sensor is incorrectly aligned with the vehicle wheels, it may result in an incorrect or missing wheel speed measurement.
57	Sensor measurement inaccurate	Sensor incorrectly aligned or positioned	If the wheel speed sensor is incorrectly aligned with the vehicle wheels, it may result in an inaccurate wheel speed measurement (e.g., within range, but the wrong value).
59	External disturbances	Manufacturing defects and assembly problems	The wheel speed sensor may be incorrectly installed relative to the vehicle wheels, resulting in an incorrect wheel speed measurement.
60	External disturbances	Physical interference (e.g., chafing)	Physical interference from the external environment (e.g., road debris) may affect the positioning of the wheel speed sensor relative to the vehicle wheels.
61	External disturbances	Mechanical connections affected by moisture, corrosion, or contamination	The mechanical connections fastening the wheel speed sensor to the vehicle may degrade prematurely as the result of moisture, corrosion, or contamination from the external environment.
62	Hazardous interaction with other components in the rest of the vehicle	Vibration or shock impact	Vibration or shock impact from other vehicle components may affect the positioning of the wheel speed sensor relative to the vehicle, resulting in an incorrect measurement of the wheel speed.
63	Hazardous interaction with other components in the rest of the vehicle	Physical interference (e.g., chafing)	Physical interference with other vehicle components may affect the positioning of the wheel speed sensor relative to the vehicle wheels.
64	Hazardous interaction with other components in the rest of the vehicle	Mechanical connections affected by moisture, corrosion, or contamination	The mechanical connections fastening the wheel speed sensor to the vehicle may degrade prematurely as the result of moisture, corrosion, or contamination from other vehicle components.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
65	External disturbances	Vibration or shock impact	Vibration or shock impact from the external environment may affect the positioning of the wheel speed sensor relative to the vehicle, resulting in an incorrect measurement of the wheel speed.
96	Sensor measurement delay	Sensor incorrectly aligned or positioned	The wheel speed sensor may be incorrectly positioned relative to the wheel, introducing a delay into the measurement.

Table I-31: Vehicle to Yaw Rate Sensor

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
567	Sensor measurement incorrect or missing	Sensor incorrectly aligned or positioned	The yaw rate sensor may be incorrectly aligned or positioned in the vehicle, preventing a yaw rate measurement or resulting in a measurement that is out-of-range.
568	Sensor measurement inaccurate	Sensor incorrectly aligned or positioned	The yaw rate sensor may be incorrectly aligned or positioned in the vehicle, preventing an inaccurate yaw rate measurement (e.g., offset).
569	External disturbances	Vibration or shock impact	Vibration or shock impact from the external environment may affect the connection between the vehicle and yaw rate sensor (e.g., displace or offset the yaw rate sensor).
570	External disturbances	Manufacturing defects and assembly problems	Manufacturing defects or assembly problems may affect the positioning of the yaw rate sensor relative to the vehicle (e.g., improper installation).
571	External disturbances	Physical interference (e.g., chafing)	Physical interference from the external environment may affect the connection between the yaw rate sensor and the vehicle (e.g., dislocate the sensor).
572	External disturbances	Mechanical connections affected by moisture, corrosion, or contamination	The mechanical connection between the yaw rate sensor and the vehicle may be damaged by moisture, corrosion, or contamination from the external environment (e.g., degradation of the mechanical fixtures holding the sensor in place).
573	Hazardous interaction with other components in the rest of the vehicle	Vibration or shock impact	Vibration or shock impact from other vehicle components may affect the connection between the vehicle and yaw rate sensor (e.g., displace or offset the yaw rate sensor).
574	Hazardous interaction with other components in the rest of the vehicle	Physical interference (e.g., chafing)	Physical interference from other vehicle components may affect the connection between the yaw rate sensor and the vehicle (e.g., dislocate the sensor).

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
575	Hazardous interaction with other components in the rest of the vehicle	Mechanical connections affected by moisture, corrosion, or contamination	The mechanical connection between the yaw rate sensor and the vehicle may be damaged by moisture, corrosion, or contamination from other vehicle components (e.g., degradation of the mechanical fixtures holding the sensor in place).

Table I-32: Wheel Speed Sensor to CHB Control Module

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
66	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connection is intermittent	If the connection between the wheel speed sensor and brake/stability control module is intermittent, the brake/stability control module may not be able to accurately determine the wheel speed.
67	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connection is open, short to ground, short to battery, or short to other wires in harness	If the connection between the wheel speed sensor and brake/stability control module has a hardware fault (e.g., open, or short to ground, battery, etc.), the brake/stability control module may not be able to accurately determine the wheel speed.
68	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Electrical noise other than EMI or ESD	Electrical noise, other than EMI or ESD, may affect the signal from the wheel speed sensor to the brake/stability control module, resulting in an incorrect wheel speed measurement.
69	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connector contact resistance is too high	If the contact resistance in the connection terminal of the wheel speed sensor or brake/stability control module is too high, the brake/stability control module may have an incorrect wheel speed measurement.
70	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connector shorting between neighboring pins	If shorting occurs between neighboring pins in the connection terminal of the wheel speed sensor or brake/stability control module, the brake/stability control module may be unable to determine the correct wheel speed.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
71	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connector resistive drift between neighboring pins	Resistive drift between neighboring pins in the connection terminal of the wheel speed sensor or brake/stability control module may affect the ability of the brake/stability control module to determine the correct wheel speed.
72	Sensor to controller signal inadequate, missing, or delayed: Communication bus error	Bus overload or bus error	If the wheel speed signal is transmitted to the brake/stability control module over the communication bus, a bus overload or bus error may prevent the brake/stability control module from receiving updated wheel speed data.
73	Sensor to controller signal inadequate, missing, or delayed: Communication bus error	Signal priority too low	If the wheel speed signal is transmitted to the brake/stability control module over the communication bus, and the signal priority for the wheel speed sensor is too low, there may be a delay before the brake/stability control module receives updated wheel speed data.
74	Sensor to controller signal inadequate, missing, or delayed: Communication bus error	Failure of the message generator, transmitter, or receiver	If the wheel speed signal is transmitted to the brake/stability control module over the communication bus, failure of the message generator, transmitter, or receiver may affect transmission of the wheel speed data.
75	Sensor to controller signal inadequate, missing, or delayed: Communication bus error	Malicious Intruder	If the wheel speed signal is transmitted to the brake/stability control module over the communication bus, a malicious intruder or aftermarket component may write an incorrect wheel speed measurement to the communication bus.
76	Sensor to controller signal inadequate, missing, or delayed: Incorrect connection	Incorrect wiring connection	The wiring connection between the wheel speed sensor and the brake/stability control module may be incorrect or reversed (e.g., left and right wheel speed sensor connections are switched).

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
77	Sensor to controller signal inadequate, missing, or delayed: Incorrect connection	Incorrect pin assignment	The connection between the wheel speed sensor and brake/stability control module may have an incorrect pin assignment, resulting in the brake/stability control module receiving an incorrect wheel speed measurement.
78	External disturbances	EMI or ESD	EMI or ESD from the external environment could affect the connection between the wheel speed sensor and brake/stability control module, resulting in the brake/stability control module receiving incorrect wheel speed data.
79	External disturbances	Vibration or shock impact	Vibration or shock impact from the external environment could affect the connection between the wheel speed sensor and brake/stability control module (e.g., causing fretting or a loose connection).
80	External disturbances	Manufacturing defects and assembly problems	Manufacturing defects or assembly problems could affect the connection between the wheel speed sensor and brake/stability control module.
81	External disturbances	Extreme external temperature or thermal cycling	Extreme external temperature or thermal cycling could affect the connection between the wheel speed sensor and brake/stability control module.
82	External disturbances	Unused connection terminals affected by moisture, corrosion, or contamination	Unused connection terminals in the wiring harness connecting the wheel speed sensor and brake/stability control module may be affected by moisture, corrosion, or contamination from the external environment (e.g., causing shorting between pins).
83	External disturbances	Organic growth	Organic growth in the connection terminal of the wheel speed sensor or brake/stability control module may affect the signal from the wheel speed sensor to the brake/stability control module (e.g., causing shorting between pins).

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
84	External disturbances	Physical interference (e.g., chafing)	Physical interference from the external environment (e.g., road debris) may damage wiring, affect the connection between the wheel speed sensor and brake/stability control module.
85	External disturbances	Active connection terminals affected by moisture, corrosion, or contamination	Moisture, corrosion, or contamination from the external environment may affect the active connection terminals of the wheel speed sensor or brake/stability control module, affecting the accuracy of the wheel speed data.
86	Hazardous interaction with other components in the rest of the vehicle	EMI or ESD	EMI or ESD from other vehicle components could affect the connection between the wheel speed sensor and brake/stability control module, resulting in the brake/stability control module receiving incorrect wheel speed data.
87	Hazardous interaction with other components in the rest of the vehicle	Vibration or shock impact	Vibration or shock impact from other vehicle components could affect the connection between the wheel speed sensor and brake/stability control module (e.g., causing fretting or a loose connection).
88	Hazardous interaction with other components in the rest of the vehicle	Excessive heat from other components	Excessive heat from other vehicle components could affect the connection between the wheel speed sensor and brake/stability control module (e.g., melt the wiring).
89	Hazardous interaction with other components in the rest of the vehicle	Unused connection terminals affected by moisture, corrosion, or contamination	Unused connection terminals in the wiring harness connecting the wheel speed sensor and brake/stability control module may be affected by moisture, corrosion, or contamination from other vehicle components (e.g., causing shorting between pins).
90	Hazardous interaction with other components in the rest of the vehicle	Physical interference (e.g., chafing)	Physical interference from other vehicle components (e.g., chafing) may damage wiring, affect the connection between the wheel speed sensor and brake/stability control module.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
91	Hazardous interaction with other components in the rest of the vehicle	Active connection terminals affected by moisture, corrosion, or contamination	Moisture, corrosion, or contamination from other vehicle components may affect the active connection terminals of the wheel speed sensor or brake/stability control module, affecting the accuracy of the wheel speed data.
92	Hazardous interaction with other components in the rest of the vehicle	Electrical arcing from neighboring components or exposed terminals	Electrical arcing from neighboring components or exposed terminals could affect the connection between the wheel speed sensor and brake/stability control module.

Table I-33: Yaw Rate Sensor to CHB Control Module

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
493	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connection is intermittent	The connection between the yaw rate sensor and brake/stability control module may become intermittent. This may affect the brake/stability control module's ability to determine the yaw error.
494	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connection is open, short to ground, short to battery, or short to other wires in harness	The connection between the yaw rate sensor and brake/stability control module may become open or shorted (e.g., to ground, battery, or other wires). This may affect the brake/stability control module's ability to determine the yaw error.
495	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Electrical noise other than EMI or ESD	Electrical noise, other than EMI or ESD, may affect the connection between the yaw rate sensor and brake/stability control module. This may affect the brake/stability control module's ability to determine the yaw error.
496	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connector contact resistance is too high	The contact resistance in the connection terminals of the yaw rate sensor or brake/stability control module may be too high. This may affect the brake/stability control module's ability to determine the yaw error.
497	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connector shorting between neighboring pins	Shorting may occur between neighboring pins in the connection terminals of the yaw rate sensor or brake/stability control module. This may affect the brake/stability control module's ability to determine the yaw error.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
498	Sensor to controller signal inadequate, missing, or delayed: Hardware open, short, missing, intermittent faulty	Connector resistive drift between neighboring pins	Resistive drift may occur between neighboring pins in the connection terminals of the yaw rate sensor or brake/stability control module. This may affect the brake/stability control module's ability to determine the yaw error.
499	Sensor to controller signal inadequate, missing, or delayed: Communication bus error	Bus overload or bus error	If the yaw rate sensor and brake/stability control module are connected over the communication bus, a bus overload or bus error may affect transmission of the yaw rate signal. This may affect the brake/stability control module's ability to determine the yaw error.
500	Sensor to controller signal inadequate, missing, or delayed: Communication bus error	Signal priority too low	If the yaw rate sensor and brake/stability control module are connected over the communication bus, the yaw rate sensor signal priority may be too low. This may delay the brake/stability control module's determination of the yaw error.
501	Sensor to controller signal inadequate, missing, or delayed: Communication bus error	Failure of the message generator, transmitter, or receiver	If the yaw rate sensor and brake/stability control module are connected over the communication bus, failure of the message generator, transmitter, or receiver may affect transmission of the yaw rate signal. This may affect the brake/stability control module's ability to determine the yaw error.
502	Sensor to controller signal inadequate, missing, or delayed: Communication bus error	Malicious Intruder	If the yaw rate sensor and brake/stability control module are connected over the communication bus, a malicious intruder or aftermarket component may write a signal to the communication bus that mimics the yaw rate signal. This may affect the brake/stability control module's ability to determine the yaw error.
503	Sensor to controller signal inadequate, missing, or delayed: Incorrect connection	Incorrect wiring connection	The wiring harness connecting the yaw rate sensor and brake/stability control module may be incorrectly wired. This may affect the brake/stability control module's ability to determine the yaw error.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
504	Sensor to controller signal inadequate, missing, or delayed: Incorrect connection	Incorrect pin assignment	The wiring harness connecting the yaw rate sensor and brake/stability control module may have an incorrect pin assignment. This may affect the brake/stability control module's ability to determine the yaw error.
505	External disturbances	EMI or ESD	EMI or ESD from the external environment may affect the connection between the yaw rate sensor and brake/stability control module. This may affect the brake/stability control module's ability to determine the yaw error.
506	External disturbances	Vibration or shock impact	Vibration or shock impact from the external environment may affect the connection between the yaw rate sensor and brake/stability control module (e.g., fretting). This may affect the brake/stability control module's ability to determine the yaw error.
507	External disturbances	Manufacturing defects and assembly problems	Manufacturing defects or assembly problems may affect the connection between the yaw rate sensor and brake/stability control module. This may affect the brake/stability control module's ability to determine the yaw error.
508	External disturbances	Extreme external temperature or thermal cycling	Extreme external temperature or thermal cycling may affect the connection between the yaw rate sensor and brake/stability control module (e.g., degrade the wiring insulation). This may affect the brake/stability control module's ability to determine the yaw error.
509	External disturbances	Unused connection terminals affected by moisture, corrosion, or contamination	Unused connection terminals in the wiring harness connecting the yaw rate sensor and brake/stability control module may be affected by moisture, corrosion, or contamination from the external environment (e.g., causing shorting). This may affect the brake/stability control module's ability to determine the yaw error.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
510	External disturbances	Organic growth	Organic growth may affect the connection terminals of the yaw rate sensor or brake/stability control module. This may affect the brake/stability control module's ability to determine the yaw error.
511	External disturbances	Physical interference (e.g., chafing)	Physical interference from the external environment (e.g., road debris) may damage the connection between the yaw rate sensor and brake/stability control module. This may affect the brake/stability control module's ability to determine the yaw error.
512	External disturbances	Active connection terminals affected by moisture, corrosion, or contamination	Moisture, corrosion, or contamination from the external environment may affect the active connection terminals of the yaw rate sensor or brake/stability control module. This may affect the brake/stability control module's ability to determine the yaw error.
513	Hazardous interaction with other components in the rest of the vehicle	EMI or ESD	EMI or ESD from other vehicle components may affect the connection between the yaw rate sensor and brake/stability control module. This may affect the brake/stability control module's ability to determine the yaw error.
514	Hazardous interaction with other components in the rest of the vehicle	Vibration or shock impact	Vibration or shock impact from other vehicle components may affect the connection between the yaw rate sensor and brake/stability control module (e.g., fretting). This may affect the brake/stability control module's ability to determine the yaw error.
515	Hazardous interaction with other components in the rest of the vehicle	Excessive heat from other components	Excessive heat from other vehicle components may affect the connection between the yaw rate sensor and brake/stability control module (e.g., melting the wiring). This may affect the brake/stability control module's ability to determine the yaw error.

Causal Factor ID	Guideword	Guideword Subcategory	Causal Factor Description
516	Hazardous interaction with other components in the rest of the vehicle	Unused connection terminals affected by moisture, corrosion, or contamination	Unused connection terminals in the wiring harness connecting the yaw rate sensor and brake/stability control module may be affected by moisture, corrosion, or contamination from other vehicle components. This may affect the brake/stability control module's ability to determine the yaw error.
517	Hazardous interaction with other components in the rest of the vehicle	Physical interference (e.g., chafing)	Physical interference from other vehicle components may damage the connection between the yaw rate sensor and brake/stability control module. This may affect the brake/stability control module's ability to determine the yaw error.
518	Hazardous interaction with other components in the rest of the vehicle	Active connection terminals affected by moisture, corrosion, or contamination	Moisture, corrosion, or contamination from other vehicle components may affect the active connection terminals of the yaw rate sensor or brake/stability control module. This may affect the brake/stability control module's ability to determine the yaw error.
519	Hazardous interaction with other components in the rest of the vehicle	Electrical arcing from neighboring components or exposed terminals	Electrical arcing from neighboring components or exposed terminals may affect the connection between the yaw rate sensor and brake/stability control module. This may affect the brake/stability control module's ability to determine the yaw error.

APPENDIX J: THREE-LEVEL MONITORING STRATEGY

The three-level monitoring strategy is a redundant design strategy that is employed to meet requirements for components that address high ASIL (C or D) hazards. When this design approach is applied to the EPS system, the EPS system will include two micro controllers: a main controller and an auxiliary controller.

The main controller is the one that runs the system. It receives the inputs, runs the algorithms, makes the decisions, and sends out the output. It is also the one that communicates with the rest of the vehicle systems, and takes the vehicle to a safe state in the case of a sufficiently severe hazard.

The sole purpose of the auxiliary controller is to ensure the health and “sanity” of the main controller. It cannot run any system controls. However, it is capable of shutting down the main controller and taking the vehicle into a safe state.

The three levels of the strategy can be described as follows:

Level 1: The main controller runs its calculations or algorithms. It re-runs them again using different calculation methods or algorithms. If the two results don’t match, a fault is set, and a fault mitigation strategy is enacted.

Level 2: The auxiliary controller collects the inputs independently, and runs the calculations or algorithms that the main controller ran, although it uses different methods and algorithms. The auxiliary controller then compares its results to those of the main controller. If the results don’t match, a fault is set, and a fault mitigation strategy is enacted.

Level 3: This level has different names in industry: “Seed & Key,” “Quizzer,” “Questions & Answers,” etc. It employs a set of scenarios or questions with pre-determined answers. The auxiliary controller poses these questions or scenarios to the main controller randomly. If the main controller does not respond correctly, then a fault is set, and a fault mitigation strategy is enacted.

APPENDIX K: DIAGNOSTIC TROUBLE CODES RELEVANT TO THE CHB SYSTEM

Table K-2. Identification of Selected SAE J2012 DTCs for the CHB System

SAE J2012 Code	Phenomenon	CHB System Component or Interface
C0001	TCS Control Channel "A" Valve 1 (Subfault)	Hydraulic Modulator
C0002	TCS Control Channel "A" Valve 2 (Subfault)	Hydraulic Modulator
C0003	TCS Control Channel "B" Valve 1 (Subfault)	Hydraulic Modulator
C0004	TCS Control Channel "B" Valve 2 (Subfault)	Hydraulic Modulator
C0010	Left Front Inlet Control (Subfault)	Hydraulic Modulator
C0011	Left Front Outlet Control (Subfault)	Hydraulic Modulator
C0012	Left Front Hydraulic Release Too Long (Subfault)	Hydraulic Modulator
C0014	Right Front Inlet Control (Subfault)	Hydraulic Modulator
C0015	Right Front Outlet Control (Subfault)	Hydraulic Modulator
C0016	Right Front Hydraulic Release Too Long (Subfault)	Hydraulic Modulator
C0018	Left Rear Inlet Control (Subfault)	Hydraulic Modulator
C0019	Left Rear Outlet Control (Subfault)	Hydraulic Modulator
C001A	Left Rear Hydraulic Release Too Long (Subfault)	Hydraulic Modulator
C001C	Right Rear Inlet Control (Subfault)	Hydraulic Modulator
C001D	Right Rear Outlet Control (Subfault)	Hydraulic Modulator
C001E	Right Rear Hydraulic Release Too Long (Subfault)	Hydraulic Modulator
C0020	ABS Pump Motor Control (Subfault)	Hydraulic Modulator
C0021	Brake Booster Performance (Subfault)	Brake Booster
C0022	Brake Booster Solenoid (Subfault)	Brake Booster
C0023	Stop Lamp Control (Subfault)	Brake Pedal Position Sensor
C0030	Left Front Tone Wheel (Subfault)	Wheel Speed Sensor
C0031	Left Front Wheel Speed Sensor (Subfault)	Wheel Speed Sensor
C0032	Left Front Wheel Speed Sensor Supply (Subfault)	Wheel Speed Sensor
C0033	Right Front Tone Wheel (Subfault)	Wheel Speed Sensor
C0034	Right Front Wheel Speed Sensor (Subfault)	Wheel Speed Sensor
C0035	Right Front Wheel Speed Sensor Supply (Subfault)	Wheel Speed Sensor
C0036	Left Rear Tone Wheel (Subfault)	Wheel Speed Sensor
C0037	Left Rear Wheel Speed Sensor (Subfault)	Wheel Speed Sensor
C0038	Left Rear Wheel Speed Sensor Supply (Subfault)	Wheel Speed Sensor
C0039	Right Rear Tone Wheel (Subfault)	Wheel Speed Sensor
C003A	Right Rear Wheel Speed Sensor (Subfault)	Wheel Speed Sensor
C003B	Right Rear Wheel Speed Sensor Supply (Subfault)	Wheel Speed Sensor
C003C	Rear Tone Wheel (Subfault)	Wheel Speed Sensor
C003D	Rear Wheel Speed Sensor (Subfault)	Wheel Speed Sensor
C003E	Rear Wheel Speed Sensor Supply (Subfault)	Wheel Speed Sensor
C0040	Brake Pedal Switch "A" (Subfault)	Brake Pedal Position Sensor
C0041	Brake Pedal Switch "B" (Subfault)	Brake Pedal Position Sensor
C0042	Brake Pedal Position Sensor "Circuit A" (Subfault)	Brake Pedal Position Sensor

SAE J2012 Code	Phenomenon	CHB System Component or Interface
C0043	Brake Pedal Position Sensor "Circuit B" (Subfault)	Brake Pedal Position Sensor
C0044	Brake Pressure Sensor "A" (Subfault)	Brake Pressure Sensor
C0045	Brake Pressure Sensor "B" (Subfault)	Brake Pressure Sensor
C0046	Brake Pressure Sensor "A"/"B" (Subfault)	Brake Pressure Sensor
C0047	Brake Booster Pressure Sensor (Subfault)	Brake Booster
C0048	Brake Booster Travel Sensor (Subfault)	Brake Booster
C004A	Brake Lining Wear Sensor (Subfault)	Brake Pad/Drum
C0061	Lateral Acceleration Sensor (Subfault)	Vehicle Dynamics/Inertial Sensors
C0062	Longitudinal Acceleration Sensor (Subfault)	Vehicle Dynamics/Inertial Sensors
C0063	Yaw Rate Sensor (Subfault)	Vehicle Dynamics/Inertial Sensors
C0064	Roll Rate Sensor	Vehicle Dynamics/Inertial Sensors
C0069	Yaw Rate/Longitude Sensors (Subfault)	Vehicle Dynamics/Inertial Sensors
C006A	Multi-axis Acceleration Sensor (Subfault)	Vehicle Dynamics/Inertial Sensors
C006B	Stability System Active Too Long (Subfault)	CHB Control Module
C006C	Stability System	CHB Control Module
C0072	Brake Temperature Too High (Subfault)	Brake Pad/Drum
C0075	Extended Brake Pedal Travel, output to PCM (Subfault)	Brake Pedal Position Sensor
C0076	PWM for Traction Control (Subfault)	CHB Control Module
C0078	Tire Diameter (Subfault)	Wheel Speed Sensor
C0089	TCS Disable Switch (Subfault)	CHB System Disable Switch
C008A	TCS Mode Control (Subfault)	CHB Control Module
P050F	Brake Assist Vacuum Too Low	Brake Booster
P0555	Brake Booster Pressure Sensor Circuit	Brake Booster
P0556	Brake Booster Pressure Sensor Circuit Range/Performance	Brake Booster
P0557	Brake Booster Pressure Sensor Circuit Low	Brake Booster
P0558	Brake Booster Pressure Sensor Circuit High	Brake Booster
P0559	Brake Booster Pressure Sensor Circuit Intermittent	Brake Booster
P0571	Brake Switch "A" Circuit	Brake Pedal Position Sensor
P0572	Brake Switch "A" Circuit Low	Brake Pedal Position Sensor
P0573	Brake Switch "A" Circuit High	Brake Pedal Position Sensor
P0856	Traction Control Input Signal	CHB Control Module
P0857	Traction Control Input Signal Range/Performance	CHB Control Module
P0858	Traction Control Input Signal Low	CHB Control Module
P0859	Traction Control Input Signal High	CHB Control Module
P215C	Output Shaft Speed - Wheel Speed Correlation	Wheel Speed Sensor
P258A	Vacuum Pump Control Circuit/Open	Brake Booster

SAE J2012 Code	Phenomenon	CHB System Component or Interface
P258B	Vacuum Pump Control Range/Performance	Brake Booster
P258C	Vacuum Pump Control Circuit Low	Brake Booster
P258D	Vacuum Pump Control Circuit High	Brake Booster
U0315	Software Incompatibility With ABS Control Module	CHB Control Module
U0316	Software Incompatibility With Vehicle Dynamics Control Module	CHB Control Module
U0317	Software Incompatibility With Park Brake Control Module	CHB Control Module
U0318	Software Incompatibility With Brake System Control Module	CHB Control Module
U0415	Invalid Data Received From ABS Control Module	CHB Control Module
U0416	Invalid Data Received From Vehicle Dynamics Control Module	Vehicle Dynamics/Inertial Sensors
U0418	Invalid Data Received From Brake System Control Module	CHB Control Module
U0432	Invalid Data Received From Multi-axis Acceleration Sensor Module	Vehicle Dynamics/Inertial Sensors
U0513	Invalid Data Received From Yaw Rate Sensor Module	Vehicle Dynamics/Inertial Sensors
U0536	Invalid Data Received From Lateral Acceleration Sensor Module	Vehicle Dynamics/Inertial Sensors
U3000	Control Module	CHB Control Module
U3001	Control Module Improper Shutdown	CHB Control Module
U3006	Control Module Input Power "A"	CHB Control Module
U3007	Control Module Input Power "B"	CHB Control Module
U3008	Control Module Ground "A"	CHB Control Module
U3009	Control Module Ground "B"	CHB Control Module

Table K-3. Identification of Selected SAE J2012 DTCs for Critical CHB System Interfaces

SAE J2012 Code	Phenomenon	Interfacing System
C0049	Brake Fluid (Subfault)	Brake Fluid Level Sensor (Instrument Panel Display)
C0051	Steering Wheel Position Sensor (Subfault)	Steering System
C0052	Steering Wheel Position Sensor "Signal A" (Subfault)	Steering System
C0053	Steering Wheel Position Sensor "Signal B" (Subfault)	Steering System
C0054	Steering Wheel Position Sensor "Signal C" (Subfault)	Steering System
C0055	Steering Wheel Position Sensor "Signal D" (Subfault)	Steering System
C0071	2/4 Wheel Drive Status Input (Subfault)	Differential System
C0073	Delivered Driving Torque (Subfault)	ACS/ETC System
C0074	Requested Driving Torque (Subfault)	ACS/ETC System
C0077	Variable Effort Steering (Subfault)	Steering System
C0079	ABS Malfunction Indicator (Subfault)	Instrument Panel Display
C0081	Brake System Malfunction Indicator (Subfault)	Instrument Panel Display
C0082	Tire Pressure Monitor Malfunction Indicator (Subfault)	Instrument Panel Display
C0083	Traction Active Indicator (Subfault)	Instrument Panel Display
C0084	Traction Disable Indicator (Subfault)	Instrument Panel Display
C0085	Vehicle Dynamics Indicator (Subfault)	Instrument Panel Display
C0086	Throttle/Pedal Position Sensor/Switch "A" Circuit	ACS/ETC System
P0120	Throttle/Pedal Position Sensor/Switch "A" Circuit Range/Performance	ACS/ETC System
P0121	Throttle/Pedal Position Sensor/Switch "A" Circuit Low	ACS/ETC System
P0122	Throttle/Pedal Position Sensor/Switch "A" Circuit High	ACS/ETC System
P0123	Throttle/Pedal Position Sensor/Switch "A" Circuit Intermittent	ACS/ETC System
P0124	Throttle/Pedal Position Sensor/Switch "B" Circuit	ACS/ETC System
P0220	Throttle/Pedal Position Sensor/Switch "B" Circuit Range/Performance	ACS/ETC System
P0221	Throttle/Pedal Position Sensor/Switch "B" Circuit Low	ACS/ETC System
P0222	Throttle/Pedal Position Sensor/Switch "B" Circuit High	ACS/ETC System
P0223	Throttle/Pedal Position Sensor/Switch "B" Circuit Intermittent	ACS/ETC System
P0224	Throttle/Pedal Position Sensor/Switch "C" Circuit	ACS/ETC System
P0225	Throttle/Pedal Position Sensor/Switch "C" Circuit Range/Performance	ACS/ETC System
P0226	Throttle/Pedal Position Sensor/Switch "C" Circuit Low	ACS/ETC System
P0227	Throttle/Pedal Position Sensor/Switch "C" Circuit High	ACS/ETC System
P0228	Throttle/Pedal Position Sensor/Switch "C" Circuit Intermittent	ACS/ETC System
P0229	Vehicle Speed Sensor "A"	Vehicle Speed Sensor (if separate from Brake/Stability Control Module)
P0500	Vehicle Speed Sensor "A" Range/Performance	Vehicle Speed Sensor (if separate from Brake/Stability Control Module)
P0501	Vehicle Speed Sensor "A" Circuit Low	Vehicle Speed Sensor (if separate from Brake/Stability Control Module)

SAE J2012 Code	Phenomenon	Interfacing System
P0502	Vehicle Speed Sensor "A" Intermittent/Erratic/High	Vehicle Speed Sensor (if separate from Brake/Stability Control Module)
P0503	Throttle/Pedal Position Sensor "B" Minimum Stop Performance	ACS/ETC System
P2113	Throttle/Pedal Position Sensor "C" Minimum Stop Performance	ACS/ETC System
P2114	Throttle/Pedal Position Sensor "D" Minimum Stop Performance	ACS/ETC System
P2115	Throttle/Pedal Position Sensor "E" Minimum Stop Performance	ACS/ETC System
P2116	Throttle/Pedal Position Sensor "F" Minimum Stop Performance	ACS/ETC System
P2117	Throttle/Pedal Position Sensor "A" Minimum Stop Performance	ACS/ETC System
P2109	Throttle/Pedal Position Sensor/Switch "D" Circuit	ACS/ETC System
P2120	Throttle/Pedal Position Sensor/Switch "D" Circuit Range/Performance	ACS/ETC System
P2121	Throttle/Pedal Position Sensor/Switch "D" Circuit Low	ACS/ETC System
P2122	Throttle/Pedal Position Sensor/Switch "D" Circuit High	ACS/ETC System
P2123	Throttle/Pedal Position Sensor/Switch "D" Circuit Intermittent	ACS/ETC System
P2124	Throttle/Pedal Position Sensor/Switch "E" Circuit	ACS/ETC System
P2125	Throttle/Pedal Position Sensor/Switch "E" Circuit Range/Performance	ACS/ETC System
P2126	Throttle/Pedal Position Sensor/Switch "E" Circuit Low	ACS/ETC System
P2127	Throttle/Pedal Position Sensor/Switch "E" Circuit High	ACS/ETC System
P2128	Throttle/Pedal Position Sensor/Switch "E" Circuit Intermittent	ACS/ETC System
P2129	Throttle/Pedal Position Sensor/Switch "F" Circuit	ACS/ETC System
P2130	Throttle/Pedal Position Sensor/Switch "F" Circuit Range/Performance	ACS/ETC System
P2131	Throttle/Pedal Position Sensor/Switch "F" Circuit Low	ACS/ETC System
P2132	Throttle/Pedal Position Sensor/Switch "F" Circuit High	ACS/ETC System
P2133	Throttle/Pedal Position Sensor/Switch "F" Circuit Intermittent	ACS/ETC System
P2134	Throttle/Pedal Position Sensor/Switch "A"/"B" Voltage Correlation	ACS/ETC System
P2135	Throttle/Pedal Position Sensor/Switch "A"/"C" Voltage Correlation	ACS/ETC System
P2136	Throttle/Pedal Position Sensor/Switch "B"/"C" Voltage Correlation	ACS/ETC System
P2137	Throttle/Pedal Position Sensor/Switch "D"/"E" Voltage Correlation	ACS/ETC System
P2138	Throttle/Pedal Position Sensor/Switch "D"/"F" Voltage Correlation	ACS/ETC System
P2139	Vehicle Speed Sensor "B"	Vehicle Speed Sensor (if separate from Brake/Stability Control Module)
P2158	Vehicle Speed Sensor "B" Range/Performance	Vehicle Speed Sensor (if separate from Brake/Stability Control Module)
P2159	Vehicle Speed - Wheel Speed Correlation	Vehicle Speed Sensor (if separate from Brake/Stability Control Module)

SAE J2012 Code	Phenomenon	Interfacing System
P215A	Vehicle Speed - Output Shaft Speed Correlation	Vehicle Speed Sensor (if separate from Brake/Stability Control Module)
P215B	Vehicle Speed Sensor "B" Circuit Low	Vehicle Speed Sensor (if separate from Brake/Stability Control Module)
P2160	Vehicle Speed Sensor "B" Intermittent/Erratic/High	Vehicle Speed Sensor (if separate from Brake/Stability Control Module)
P2161	Vehicle Speed Sensor "A"/"B" Correlation	Vehicle Speed Sensor (if separate from Brake/Stability Control Module)
P2162	Throttle/Pedal Position Sensor "A" Maximum Stop Performance	ACS/ETC System
P2163	Throttle/Pedal Position Sensor "B" Maximum Stop Performance	ACS/ETC System
P2164	Throttle/Pedal Position Sensor "C" Maximum Stop Performance	ACS/ETC System
P2165	Throttle/Pedal Position Sensor "D" Maximum Stop Performance	ACS/ETC System
P2166	Throttle/Pedal Position Sensor "E" Maximum Stop Performance	ACS/ETC System
P2167	Throttle/Pedal Position Sensor "F" Maximum Stop Performance	ACS/ETC System
P2168	High Speed CAN Communication Bus	Vehicle Communication System
U0001	High Speed CAN Communication Bus Performance	Vehicle Communication System
U0002	High Speed CAN Communication Bus (+) Open	Vehicle Communication System
U0003	High Speed CAN Communication Bus (+) Low	Vehicle Communication System
U0004	High Speed CAN Communication Bus (+) High	Vehicle Communication System
U0005	High Speed CAN Communication Bus (-) Open	Vehicle Communication System
U0006	High Speed CAN Communication Bus (-) Low	Vehicle Communication System
U0007	High Speed CAN Communication Bus (-) High	Vehicle Communication System
U0008	High Speed CAN Communication Bus (-) shorted to Bus (+)	Vehicle Communication System
U0009	Medium Speed CAN Communication Bus	Vehicle Communication System
U0010	Medium Speed CAN Communication Bus Performance	Vehicle Communication System
U0011	Medium Speed CAN Communication Bus (+) Open	Vehicle Communication System
U0012	Medium Speed CAN Communication Bus (+) Low	Vehicle Communication System
U0013	Medium Speed CAN Communication Bus (+) High	Vehicle Communication System
U0014	Medium Speed CAN Communication Bus (-) Open	Vehicle Communication System
U0015	Medium Speed CAN Communication Bus (-) Low	Vehicle Communication System
U0016	Medium Speed CAN Communication Bus (-) High	Vehicle Communication System
U0017	Medium Speed CAN Communication Bus (-) shorted to Bus (+)	Vehicle Communication System
U0018	Low Speed CAN Communication Bus	Vehicle Communication System
U0019	Low Speed CAN Communication Bus Performance	Vehicle Communication System
U0020	Low Speed CAN Communication Bus (+) Open	Vehicle Communication System
U0021	Low Speed CAN Communication Bus (+) Low	Vehicle Communication System
U0022	Low Speed CAN Communication Bus (+) High	Vehicle Communication System

SAE J2012 Code	Phenomenon	Interfacing System
U0023	Low Speed CAN Communication Bus (-) Open	Vehicle Communication System
U0024	Low Speed CAN Communication Bus (-) Low	Vehicle Communication System
U0025	Low Speed CAN Communication Bus (-) High	Vehicle Communication System
U0026	Low Speed CAN Communication Bus (-) shorted to Bus (+)	Vehicle Communication System
U0027	Vehicle Communication Bus A	Vehicle Communication System
U0028	Vehicle Communication Bus A Performance	Vehicle Communication System
U0029	Vehicle Communication Bus A (+) Open	Vehicle Communication System
U0030	Vehicle Communication Bus A (+) Low	Vehicle Communication System
U0031	Vehicle Communication Bus A (+) High	Vehicle Communication System
U0032	Vehicle Communication Bus A (-) Open	Vehicle Communication System
U0033	Vehicle Communication Bus A (-) Low	Vehicle Communication System
U0034	Vehicle Communication Bus A (-) High	Vehicle Communication System
U0035	Vehicle Communication Bus A (-) shorted to Bus A (+)	Vehicle Communication System
U0036	Vehicle Communication Bus B	Vehicle Communication System
U0037	Vehicle Communication Bus B Performance	Vehicle Communication System
U0038	Vehicle Communication Bus B (+) Open	Vehicle Communication System
U0039	Vehicle Communication Bus B (+) Low	Vehicle Communication System
U0040	Vehicle Communication Bus B (+) High	Vehicle Communication System
U0041	Vehicle Communication Bus B (-) Open	Vehicle Communication System
U0042	Vehicle Communication Bus B (-) Low	Vehicle Communication System
U0043	Vehicle Communication Bus B (-) High	Vehicle Communication System
U0044	Vehicle Communication Bus B (-) shorted to Bus B (+)	Vehicle Communication System
U0045	Vehicle Communication Bus C	Vehicle Communication System
U0046	Vehicle Communication Bus C Performance	Vehicle Communication System
U0047	Vehicle Communication Bus C (+) Open	Vehicle Communication System
U0048	Vehicle Communication Bus C (+) Low	Vehicle Communication System
U0049	Vehicle Communication Bus C (+) High	Vehicle Communication System
U0050	Vehicle Communication Bus C (-) Open	Vehicle Communication System
U0051	Vehicle Communication Bus C (-) Low	Vehicle Communication System
U0052	Vehicle Communication Bus C (-) High	Vehicle Communication System
U0053	Vehicle Communication Bus C (-) shorted to Bus C (+)	Vehicle Communication System
U0054	Vehicle Communication Bus D	Vehicle Communication System
U0055	Vehicle Communication Bus D Performance	Vehicle Communication System
U0056	Vehicle Communication Bus D (+) Open	Vehicle Communication System
U0057	Vehicle Communication Bus D (+) Low	Vehicle Communication System
U0058	Vehicle Communication Bus D (+) High	Vehicle Communication System
U0059	Vehicle Communication Bus D (-) Open	Vehicle Communication System
U0060	Vehicle Communication Bus D (-) Low	Vehicle Communication System
U0061	Vehicle Communication Bus D (-) High	Vehicle Communication System

SAE J2012 Code	Phenomenon	Interfacing System
U0062	Vehicle Communication Bus D (-) shorted to Bus D (+)	Vehicle Communication System
U0063	Vehicle Communication Bus E	Vehicle Communication System
U0064	Vehicle Communication Bus E Performance	Vehicle Communication System
U0065	Vehicle Communication Bus E (+) Open	Vehicle Communication System
U0066	Vehicle Communication Bus E (+) Low	Vehicle Communication System
U0067	Vehicle Communication Bus E (+) High	Vehicle Communication System
U0068	Vehicle Communication Bus E (-) Open	Vehicle Communication System
U0069	Vehicle Communication Bus E (-) Low	Vehicle Communication System
U0070	Vehicle Communication Bus E (-) High	Vehicle Communication System
U0071	Vehicle Communication Bus E (-) shorted to Bus E (+)	Vehicle Communication System
U0072	Control Module Communication Bus "A" Off	Vehicle Communication System
U0073	Control Module Communication Bus "B" Off	Vehicle Communication System
U0074	Lost Communication With ECM/PCM "A"	Vehicle Communication System
U0100	Lost Communication With Battery Energy Control Module "A"	Vehicle Communication System
U0111	Lost Communication With Battery Energy Control Module "B"	Vehicle Communication System
U0112	Lost Communication With ECM/PCM "B"	Vehicle Communication System
U0115	Lost Communication With Anti-Lock Brake System (ABS) Control Module	Vehicle Communication System
U0121	Lost Communication With Vehicle Dynamics Control Module	Vehicle Communication System
U0122	Lost Communication With Yaw Rate Sensor Module	Vehicle Communication System
U0123	Lost Communication With Lateral Acceleration Sensor Module	Vehicle Communication System
U0124	Lost Communication With Multi-axis Acceleration Sensor Module	Vehicle Communication System
U0125	Lost Communication With Steering Angle Sensor Module	Vehicle Communication System
U0126	Lost Communication With Park Brake Control Module	Vehicle Communication System
U0128	Lost Communication With Brake System Control Module	Vehicle Communication System
U0129	Lost Communication With Power Steering Control Module	Vehicle Communication System
U0131	Lost Communication With Power Steering Control Module Rear	Vehicle Communication System
U0134	Lost Communication With Differential Control Module Front	Vehicle Communication System
U0135	Lost Communication With Differential Control Module Rear	Vehicle Communication System
U0136	Lost Communication With Instrument Panel Cluster (IPC) Control Module	Vehicle Communication System
U0155	Lost Communication With Parking Assist Control Module "A"	Vehicle Communication System
U0159	Lost Communication With Rain Sensing Module	Vehicle Communication System
U0231	Lost Communication With Cruise Control Front Distance Range Sensor	Vehicle Communication System
U0235	Lost Communication With Cruise Control Front Distance Range Sensor	Vehicle Communication System
U023D	Lost Communication With Cruise Control Front Distance Range Sensor	Vehicle Communication System

SAE J2012 Code	Phenomenon	Interfacing System
U023E	Lost Communication With Parking Assist Control Module "B"	Vehicle Communication System
U0243	Invalid Data Received From ECM/PCM "A"	ACS/ETC System
U0401	Invalid Data Received From Park Brake Control Module	Other Vehicle Systems (ACC, Parking Assist, etc.)
U0417	Invalid Data Received From Power Steering Control Module	Steering System
U0420	Invalid Data Received From Steering Angle Sensor Module	Steering System
U0428	Invalid Data Received From Cruise Control Front Distance Range Sensor	Other Vehicle Systems (ACC, Parking Assist, etc.)
U0433	Invalid Data Received From Power Steering Control Module Rear	Steering System
U0435	Invalid Data Received From Differential Control Module Front	Differential System
U0436	Invalid Data Received From Differential Control Module Rear	Differential System
U0437	Invalid Data Received From Trailer Brake Control Module	Other Vehicle Systems (ACC, Parking Assist, etc.)
U0438	Invalid Data Received From Cruise Control Front Distance Range Sensor	Other Vehicle Systems (ACC, Parking Assist, etc.)
U043B	Invalid Data Received From Cruise Control Front Distance Range Sensor	Other Vehicle Systems (ACC, Parking Assist, etc.)
U043C	Invalid Data Received From ECM/PCM "B"	ACS/ETC System
U0442	Invalid Data Received From Parking Assist Control Module "A"	Other Vehicle Systems (ACC, Parking Assist, etc.)
U045A	Invalid Data Received From Rain Sensing Module	Rain Sensor
U0532	Invalid Data Received From Parking Assist Control Module "B"	Other Vehicle Systems (ACC, Parking Assist, etc.)
U0544	Battery Voltage	Low Voltage Power Supply

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